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MECHANICAL ENGINEERING

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ANNUAL MEETING NUMBER

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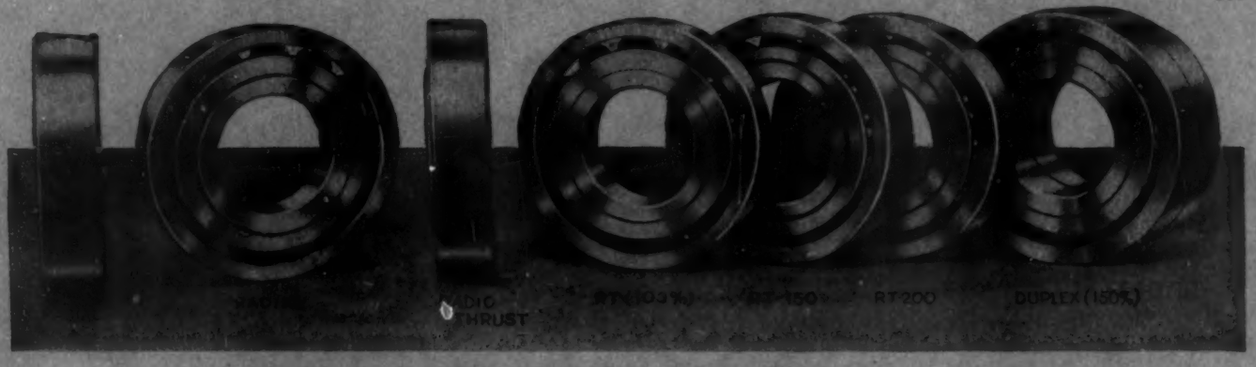

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GURNEY

Spring Meeting

The Spring Meeting for 1919 will be held at Detroit and the date has been tentatively announced as June 17 to 20.

Coming Sections Meetings

Buffalo: A meeting has been arranged for January 29, at the Hotel Statler, at 8.30 p. m. Nathan L. Lieberman will deliver an address on Horsepower Requirements of Aeroplanes and Power Consumption through Parasite Resistance.

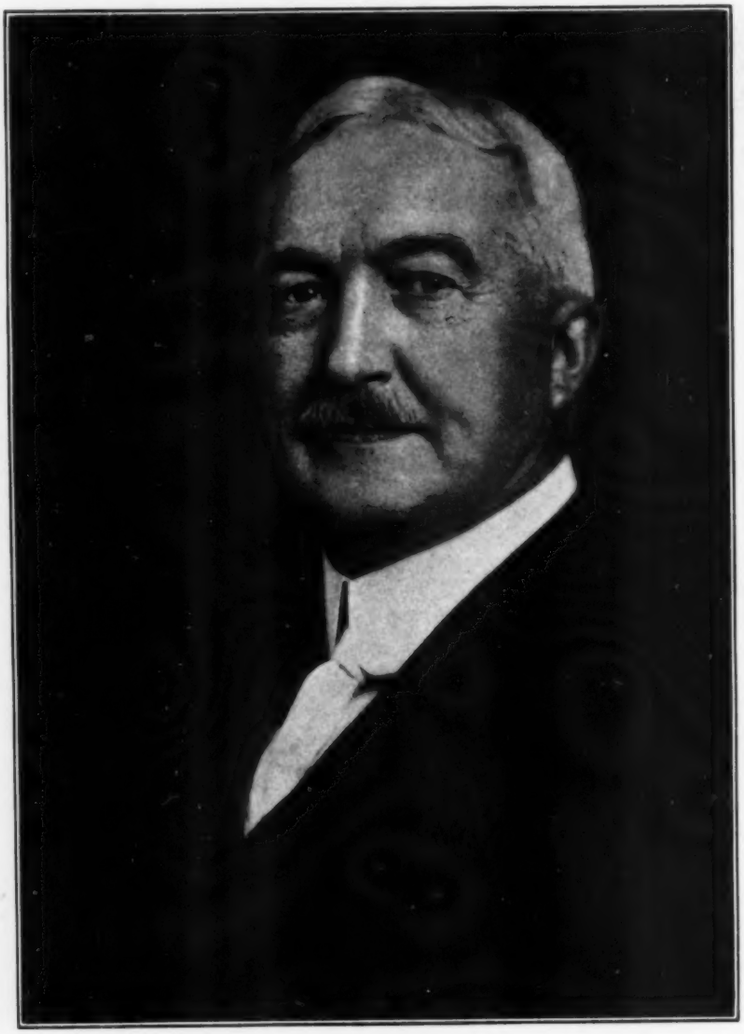
Minnesota: On January 6 the Section will hold a regular meeting at the Midway Branch of the St. Paul Association of Commerce. Prof. Peter Christianson of the School of Mines, University of Minnesota, will deliver the address of the evening.

New Haven: Douglas K. Warner will speak before the members of the New Haven Branch on January 8, at 8 p. m., in the Mason Laboratory. The subject of his address will be Friction of Ball Bearings.

New York: A meeting is planned early in January at the Engineering Societies Building, at which W. W. Macon, Chairman of the Executive Committee of the New York Section, will relate his experiences abroad as a member of the delegation of technical editors.

Philadelphia: The Section will hold its monthly meeting in the Engineers' Club on January 28. William B. Dickson, Vice-President and Treasurer of the Midvale Steel and Ordnance Company, New York, will deliver an address on the subject of Relations between Employer and Employee.

San Francisco: The Section is planning an informal smoker to be held at the Engineers' Club early in January.



MORTIMER ELWYN COOLEY
PRESIDENT 1919
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

MECHANICAL ENGINEERING

THE JOURNAL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Volume 41 January, 1919 Number 1

THE ANNUAL MEETING

THE thirty-ninth Annual Meeting of the Society held December 3 to 6, was a meeting strong and well-rounded out in its various elements, professionally and socially, simply conducted in accord with the spirit of the times, yet an occasion of very genuine pleasure to the large number in attendance. The total registration was 1717, of whom 1040 were members.

In this number of THE JOURNAL will be found an account of many of the features, including the conferring of Honorary Membership at the opening session and the President's address; the keynote session; the evening lectures, the important business meeting and the deliberations of the newly-formed Committee on Aims and Organization, the largest committee of the Society, representative of the Sections as well as of the Society at large. Accounts of the strictly technical sessions, those devoted to machine-shop subjects, refrigeration, power plants, textiles and miscellaneous subjects are reserved for a future number.

All of the events were held in the Engineering Societies Building. On Monday and Tuesday the Committee on Aims and Organization held several conferences, the conclusions of which were summarized in a progress report presented at the Business Session on Wednesday morning by the Chairman, L. C. Marburg, and published complete in this number.

President Main's address on Tuesday evening on Broader Opportunities for the Engineer voiced the desire for greater usefulness and the need for greater responsibilities which is felt alike by those in all professions and walks of life at the present time. The evening of the President's address was made still more notable by the double distinction of Honorary Membership conferred upon Charles M. Schwab and Orville Wright, with happy and appropriate remarks interspersed by Dr. John A. Brashear.

On each of the other evenings, Wednesday and Thursday, were lectures of wide appeal covering some of the important engineering work of the Army and Navy. On Wednesday evening Lieut.-Commander William L. Catheart spoke on the Engineering Achievements of the Bureau of Steam Engineering During the War, illustrated by many lantern slides. He was followed by Lieut-Commander D. C. Buell, who gave the first showing before a public audience of slides and moving pictures of the high-powered 14-in. navy guns with railway mount which were used effectively at the close of the war in breaking the line of communication with Metz. On Thursday evening Colonel James B. Dillard of the Ordnance Department reviewed the engineering features of heavy railway artillery of this and other countries. It is a pleasure to be able to publish liberal abstracts of all of these lectures in this number of THE JOURNAL.

Following the lecture on Thursday evening was the customary reunion and dance with refreshments, and an innovation was the decorating of the foyer floor of the Engineering Societies Building so that a social time could be in process in the large hall on this floor at the same time that dancing was in process on the fifth floor of the building, a feature that all seemed to appreciate.

PROFESSIONAL SESSIONS

Several months ago the Committee on Meetings and Program, sensing the spirit of the times in relation to labor problems, planned for a session to last throughout one day of the Annual Meeting on the human elements that enter into these problems. This session was introduced by Dr. L. S. Rowe, Assistant Secretary of the Treasury. He was followed by others who dealt with various phases of the employment question here at home. This session was attended by a large number, both morning and afternoon, and drew out a great deal of discussion. A brief account of the discussion is given in this number.

A strong session was arranged by the Sub-Committee on Machine-Shop Practice which accorded with the efforts put forth by the Society for the standardization of master gages by the Bureau of Standards as a central point during war production; and the appointment by the Department of Commerce of the Screw Thread Commission as a result of Congressional action. Papers were presented reviewing the work of standardization accomplished by the British Engineering Standards Association and of practice in this country of thread-gage making and testing. Exhibits of gage-testing apparatus were arranged in the building by the Bureau of Standards and by the Joint Gage Laboratories of the British War Mission and the U. S. Bureau of Aircraft Production.

A pleasing event was the joint session with the American Society of Refrigerating Engineers, to which both societies contributed papers in which a great deal of interest was evidenced.

As at the several recent annual meetings, the Sub-Committee on Textiles prepared a strong session covering problems that mill engineers have to deal with; and one paper in particular attracted considerable attention, outlining as it did the work of the Bureau of Standards in developing a cotton fabric for use as a covering for airplane wings in the place of linen.

A session which drew out a large amount of discussion was that at which the paper on the Weights and Measures of Latin America by Frederick A. Halsey was presented, followed by a paper on Efficiency and Democracy by H. L. Gantt.

On Friday morning, owing to the absence of several authors, the two sessions planned upon power-plant and general subjects were combined into one general session.

ADDRESS BY DR. GEORGE W. KIRCHWEY

The plan of a luncheon, followed by an address, inaugurated so successfully last year was carried out again, on Wednesday of the meeting, with an address by Dr. George W. Kirchwey, formerly Dean of the Columbia Law School, on A Message from the Legal Profession; or, as Dr. Kirchwey very modestly said, from "the profession which is concerned mostly with the past to the profession that looks mostly into the future." Dr. Kirchwey said in part:

"As I understand it now, you are passing through an enlarging experience. You are members of a profession by the same token that medicine and law are professions, by virtue of the fact that to your specialized technical training there is added a recognition of your social obligation to make that training available for the good of the larger community. That you are doing in a conspicuous degree, in a rather exceptional way as compared with other professions, because your work is primarily public work. You cannot if you would hide your light under a bushel as the parochial lawyer or the parochially minded doctor may easily do, because you are constructing works of public utility. Nevertheless, for the most part the work appears to the onlooker to be a series of jobs—a job performed for the owner who hires you whether he be Uncle Sam or a private employer. . . .

"It was due more to historic accident than anything else that the legal profession became a public institution; that there was committed to it the actual administration in the courts, and almost of necessity the actual work of amending and reframing the law in the legislatures and Congress. Thus the legal profession has been thrust forward into a position of vast public service, and therefore of public observation; and may I say generally of public appreciation? . . . .

"The doctor, too easily concealing his light under a bushel, has of late years also emerged from obscurity. It is because of recent discoveries in the field of science, the germ theory of disease, to lump it together into a phrase, and some of the larger applications, that the medical profession has suddenly been transformed from one rendering service to individuals to one rendering a wholesale service to the entire community. . . .

"I take it that the greatest achievements of the engineer are performed largely in the spirit that the lawyer argues his case in behalf of a public or private client, or the doctor treats his patients, doing it in the most genuine professional spirit, but falling short in utility to the community at large, that larger community service which the doctor is now performing and which the lawyer in his administration of justice is performing.

"Now," said the speaker, "I am going to invite you all to join the new society of engineers which I have decided since getting on my feet to create, the society of social engineers. You and a few lawyers are eligible (laughter). What I am getting at is this: that under conditions as they exist today no one can any longer wash his hands after the manner of Pilate and say, 'What is this to me? Go and deal with this case as you think best if you are interested. I am not.' That is no longer a tolerable attitude for any man who belongs to a profession and claims the dignity and the rewards that go with devotion to a profession. You have been dealing with material things and in the process have created new social problems. The enormous aggregation of men in our great cities, their congestion, has been due to the lines of transportation that you have set up and to the facilities for manufacturing that you have concentrated. You are responsible for this mess which we call modern civilization (laughter and applause) and it is up to you to get us out of that mess."

Referring to conditions of employment and labor he said there must somehow be devised by some engineering genius a method of stabilizing industry so that it shall no longer be subject to those extraordinary fluctuations which bring so much misery in their train and there must be devised some method of adjusting the relations between employer and employee so that they shall work together harmoniously to a common end.

CONCLUDING EXERCISES

The Annual Meeting concluded on Friday morning with a brief service of a religious character, addressed by Rev. Edmund M. Wylie of Montclair, N. J., lately in charge of Y. M. C. A. work in Great Britain and who has visited the whole of the Western Front. At this time Dr. Hollis who was in the chair recalled that the concluding session of the previous Annual Meeting had ended in silent prayer that another year might find our boys on the way home after a glorious victory. This hope had been realized and it was only fitting that we should close this year's sessions by a few words from one of the returning soldiers, a soldier of the cross, who went to St. Mihiel with one of our divisions and was present at that great victory.

Rev. Mr. Wylie said that nothing had impressed him so much in the spirit of service which the world is learning anew as the work of the engineers. He instanced many cases of the boys at the front becoming enthusiastic about the preparatory work accomplished by the engineers, both at home and abroad. The most striking illustration was of the battle of St. Mihiel. The French had held the salient against the Germans for a few days at a cost of 14,000 lives. It was captured by the Germans; and in two days the French recaptured it and held it 40 minutes at a cost of 20,000 lives. Before the first American division made its charge the engineers had said, "You can take it with little loss of life if a certain plan is followed." The preparations were made and because of their thoroughness the Americans captured St. Mihiel with a loss of only 60 men in dead and wounded.

"So," he said, "I come back with Paul's idea, that he should make himself servant unto all men. I believe the engineer's idea is the democratizing of all service; to make oneself a servant unto all mankind. We have not only blown to pieces old dynasties but outworn creeds which have separated us (applause); and I have never known the world so united on essentials as now.

"I believe what I found characterizing the soldiers of the different nationalities properly characterizes the engineers. I have heard the British catch up their slogan, 'Carry on! Carry on!' I have stood in the valley of the Marne where Joffre stood when he said, 'Defenders of France we retreat no further, we die here.' I have stood on the heights of Verdun and have heard again the voice of Petain saying, 'Il ne passeront'—they shall not pass; and as I went down 150 miles of the lines occupied in part by the Americans I discovered not only 'Carry on!' but '*Carry through! Carry through!*' I am rejoiced to stand here, your prayer answered this day, to say that our boys are on their way home after the glorious victory."

ENGINEERING AND THE WAR

"I shall never forget the impression made on me by the late Lord Kitchener, the man who started the first movements in this great war, when he said—'Mr. Schwab, this is not a war of men; it is a war of machines, and the nation and the army that will supply the machinery of war will be the ones that will win this war, and the quicker and the more expeditiously the machinery of warfare is supplied, the quicker will this war be won.' How almost prophetic was that statement, as subsequent events developed its truth, because, after all, this war has been won for us by the splendid engineering and industrial talent of the United States."—Charles M. Schwab.

ENGINEERING IN THE PERIOD OF READJUSTMENT

"The future will have problems and trials. The contests will not be of battle, but of industry. The conquests will not be of territory or thrones, but of markets.

"Upon our ability to resume our normal lines will depend to a large degree our prosperity at home and trade expansion abroad. We were unprepared for war and it has been a stupendous task to readjust our industries to a war basis. It will be no easy task to readjust ourselves for peace. In this readjustment our vision must extend beyond the state and nation out into the broad world."—President Main.

OPENING SESSION, TUESDAY EVENING

Presidential Address on Broader Opportunities for the Engineer—Introduction of the President-Elect—Conferring of Honorary Membership on Charles M. Schwab and Orville Wright

THE opening session of the thirty-ninth Annual Meeting was held in the auditorium of the Engineering Societies Building on Tuesday evening, December 3, when Mr. Charles T. Main delivered his presidential address on Broader Opportunities for the Engineer to a large and appreciative audience. President Main's address dealt with the work of the Society during the year of his incumbency and in particular with the many war activities of the Society as a body and of the membership as individuals. A wealth of interesting facts was also brought out regarding the technical work conducted by the Society, and various national developments in which the engineering profession could be of assistance and guidance were pointed out, as well as important problems in economics to whose right solution the efforts of engineers should be directed during the coming days of reconstruction. The text of the address appears elsewhere in this issue.

At the close of President Main's address the Tellers of Election reported through the Secretary that the following officers of the Society had been elected for the coming year:

President:
MORTIMER E. COOLEY
Vice-Presidents:
F. R. LOW
HENRY B. SARGENT
JOHN A. STEVENS
Managers:
CHARLES L. NEWCOMB
F. O. WELLS
C. RUSS RICHARDS
Treasurer:
WILLIAM H. WILEY

President Main then introduced President-elect Mortimer E. Cooley in a few sentences recounting briefly his professional attainments, and as a teacher, administrator, successful engineer and one of the best types of public servants he prophesied for him unusual success in his relations with the membership.

PRESIDENT-ELECT COOLEY RESPONDS

President-elect Cooley, in responding, thanked the speaker for the sentiments he had expressed, and remarked on the tension under which he had been as the time approached for his assumption of the responsibilities of the high office to which he had been elected. He recalled the first meeting of the Society which he had attended—at Pittsburgh, in May 1884—where only 93 persons were present, contrasting it with the audience before him, and spoke of the impressions made on him by the men then active in the affairs of the Society, mentioning Professor Sweet, Dr. Brashear and Charles T. Porter by name. It would be his prayer that he might do what lay in his power to carry out the program outlined in President Main's address, which could not fail to constitute a high and memorable work in the reconstruction of this country if successfully done, as he was sure it could be.

BON VOYAGE TO PRESIDENT MAIN

At the conclusion of Dean Cooley's remarks, Past-President Ira N. Hollis arose and made a statement to the effect that a few weeks before M. Millerand, President of the French Engineering Congress, had invited the American Society of Civil Engineers to send to France a delegation of engineers to engage in reconstruction work in the devastated lands. With great generosity and kindness and that brotherly relation which it was hoped might always prevail between engineering societies, the Board of Direction of the American Society of Civil Engineers had decided that they ought to share this honor with other engineering societies, and thereupon had invited The American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Institute of Electrical Engineers to join them in this great work abroad.

The announcement he desired to make was that, through the good wishes and consent of the Council of the Society, President Main would represent the Society abroad.

"Happy is the man who has this opportunity," said Dr. Hollis, "and happy should the members of this Society be because they have so good a representative to send abroad to lend a hand to our little sister of nations on the other side who stood at Liège and turned back the German hordes that the land of freedom might be saved. Happy, too, is he who is able to extend assistance to France, the country that gave us our impulse toward democracy, by the Revolutionary War, and gave us help to end it, and end that kind of autocracy which never since has existed in Anglo-Saxon countries.

"I have risen here at the request of the Council to wish Mr. Main a splendid voyage to the other side, and that he may perform that kind of successful work that we are delighted to give to those who have saved for us and for all humanity the freedom of the individual." [Applause.]

CHARLES M. SCHWAB MADE AN HONORARY MEMBER

President Main voiced his deep appreciation of the good wishes expressed by the previous speaker, and then continued:

"It has been said many times that to win the war we must have the plants to manufacture the implements for the control of the sea and air. As soon as this country declared war there was started a gigantic program in shipbuilding—but under conditions which soon became impossible, and it was necessary for the President of the United States to select the greatest man in industrial affairs, who had the necessary knowledge, force and action, and put this man in charge, without restrictions, of this gigantic undertaking. This man he found in the person of Charles M. Schwab, and in some way persuaded him to undertake the work.

"Mr. Schwab has been honored by membership in many societies and industrial organizations in this country and in Europe, and it is our great privilege tonight to show him our appreciation of his engineering ability, keen judgment, boundless energy and great patriotism in assuming and carrying through the biggest shipbuilding plan ever undertaken, at a time when his services were also urgently needed by the Government.

"To give a little personal touch to this matter I have asked a dear old friend of Mr. Schwab, 'Uncle John' Brashear, to say a few words."

Dr. Brashear, in responding, began by stating that of all the degrees and titles he possessed, none was more highly prized by him than the one under which he had been introduced and which had been conferred upon him by his friend of many years, Mr. Schwab. He recalled many incidents of his long acquaintance with Mr. Schwab and cited numerous instances where he had shown his readiness to lend financial assistance for the furtherance of scientific projects.

"Among the men I have known who have been interested in science and engineering," continued Dr. Brashear, "are the many who had human hearts in them. Unless you have that human touch in your souls, unless that is back of your scientific work, all that you have accomplished will be less effective than if you had such impulses. [Applause.]

"Why has Mr. Schwab succeeded in his great work? Not because he was an engineer away above all the rest of his fellows, not because he had a reputation for his wonderful engineering work, great as it was, but because he had that something in his heart that won him favor among the people whom he met, and we delight to honor him because he has set us an example of the human side of engineering—an example worthy of being followed by every engineer.

It's the human touch in this world that counts
The touch of your hand and mine,
That counts far more to the sinking heart
Than shelter or bread or wine;

For shelter is gone, when the day is o'er
And bread lasts only a day,
But the touch of the hand and the sound of the voice
Live on in the soul alway.

"God Bless Uncle Charley," [Loud applause.]

President Main then formally conferred the Honorary Membership upon Mr. Schwab, who responded in part as follows:

MR. SCHWAB'S ACCEPTANCE OF HONORARY MEMBERSHIP

"First of all let me pay the tribute to my old friend 'Uncle John' Brashear that he deserves. I have known him since

CHARLES M. SCHWAB

boyhood. I, like himself, have met many distinguished men in my life, and it has been a great pleasure to me to say publicly, and have it quoted all over the world, that of all the great men I have ever known I regard 'Uncle John' Brashear as the greatest of them all. [Applause.]

"I thank you sincerely, Mr. President, more sincerely than any words of mine may express for the honor that you have given me tonight. Very often it is the popular acclaim, many think, which makes a thing worth while having. A great scientific society like this is not usually swayed by any popular acclaim or theatrical performance or popular deed. There is nothing in life that one cherishes so much as the good opinion of the people who know him. It is not the great public reputation that brings satisfaction to the human heart of the men worth while, but it is the acclaim and approval of the people who have known him and have known what he has done, and there is no honor that I have ever received, and there is no acclaim to which my ears have ever listened, that will bring me a deeper sense of real satisfaction and pleasure than the approval of this great engineering society of the United States. [Loud applause.]

"There are some sounds that are very sweet to the ears of the real man; one of them, as I have stated, is the approval of those who know, the other is the approval of those with whom you work, and during this great undertaking, during our national crisis, an equally pleasing sound to my ears has been the sound of the workingmen throughout the shipyards and factories and engineering works of the United States when their voices above the din of the hammers could be heard saying—'We are with you, Charley; we are with you, Charley,' and I can assure you that every man, however high his station in life, will only give his best efforts under the approval of his fellow man and those with whom he is associated. [Loud applause.]

"Now I lay no claim to distinction as an engineer. I have spent my life in engineering projects—only the earlier part in actual engineering work and that long since forgotten—but I wonder if it has occurred to you that this great war for the freedom of the nations of the world and of our great and glorious nation, has been won by the work and influence of the engineers?

"I remember with much vivid distinctness my friendship for, and association with, the late Lord Kitchener, that great English general, the man who started the first movements in this great war. When I sat with him in his office and saw the look of responsibility that rested upon his face, this simple great soldier in plain suit of khaki, without any decorations, an impression was left that shall never be forgotten when he said—'Mr. Schwab, this is not a war of men, it is a war of machines, and the nation and the army that will supply the machinery of war will be the ones that will win this war, and the quicker and the more expeditiously the machinery of warfare is supplied, the quicker will this war be won.' How almost prophetic was that statement, as subsequent events developed its truth, because, after all, this war has been won for us by the splendid engineering and industrial talent of the United States.

"When I was asked to undertake the shipbuilding program, it seemed so prodigious in its requirements as to stagger the imagination, and I can assure you that after a week or ten days in touch with the project had given me a realization of what it meant, I would have given anything in the world to have been free of the responsibility that was placed upon me, when I saw the magnitude of what had to be accomplished. I feared at first that I should not have the responsibility and the right to do it in my own way, and it was not long until I feared the responsibility itself, and longed for the opportunity to share it with others.

"But I immediately found, as is always the case in a great emergency, that it was not a problem of the creation of machines and methods of doing things—that if it was to be done at all, it was to be done through what I called 'human engineering,' and that was the interest to the highest degree of the men in the shipyards who had to do the work. As a result of undertaking this work I went away from my office and everything connected with it, and spent ninety per cent of my time with the superintendents and the foremen and the workmen in the shipyards of the United States, and such a response as I received from every man connected with the industry is perhaps unparalleled in the history of any nation. [Applause.] I want to take this opportunity of saying that I know of not a single man in the whole shipbuilding fraternity—and there are 180 shipyards in existence in the United States—who is not fired with the spirit of intense enthusiasm and loyalty to plunge ahead and give the greatest possible effort, and during all that time there was never a single occasion when I was obliged or did say to any man connected with the industry—'You are not doing your best,' or 'You are not doing your duty.' [Applause.]

"The men at the head of that great enterprise were just as susceptible to the approval of the Director General and the American Nation as the workmen in the ranks were, and I have yet, as I said before, to find a man of high character, whether he be the King of England or the President of the United States, who is not pleased with the approval of the public in what he is doing. [Applause.]

"I must take this opportunity of paying a compliment to the workmen of the United States—I have never seen greater enthusiasm and greater effort upon the part of the workmen, indus-

trially, to win this war than I have found in the shipyards of the United States.

Our Accomplishments in Shipbuilding

"I must tell you briefly some of the accomplishments. The United States in no year prior to this war had ever constructed more than 400,000 deadweight tons of ships. General Goethals told me, when I started, that if the war continued on and during the year 1919 that 18 million tons of additional shipping to the world's then existing shipping would be necessary to maintain the armies in Europe, and that the plans for shipbuilding had to be on a basis that would give us at least 700,000 deadweight tons of ships for every month in the year 1919. It seemed a tremendous undertaking, but we continued to forge rapidly ahead until in the month of November, just ended, we placed in commission on the seas something over 500,000 deadweight tons of ships, and we will have placed in commission by the end of this year between 3,500,000 and 4,000,000 deadweight tons of shipping. [Applause.]

"When it was reported on the Fourth of July last that one hundred great ships throughout the United States had taken their plunge in the water, I felt that this war was won, because the workmen of the shipbuilding yards of the United States were going to their duty—and they have done their duty, and no credit should be given to the men at Washington like myself—I have always said that as long as I have a tongue to speak and ears to listen, I shall give the credit where credit is due. It is not the head man at Washington or at Philadelphia, the Director General or anybody else, to whom the credit for the successful accomplishments of this undertaking should be given—and if he had possessed all the talent and ability of the combined engineers in this great Society, he could not have accomplished it without the thoroughgoing and interested coöperation of every manager, superintendent and workman in the shipbuilding industry; and to them belongs the credit and let credit be given where credit is due. [Applause.]

"It has been a pleasure to be associated in such a great undertaking, to see its successful fruition and accomplishment, to have been a part of it, to have built ships to maintain our boys across the sea and carry them over. The real pleasure, however, is to build the ships and equip the ships to bring home those victorious boys of ours [applause], and when the history of this war is written it will not be the man who has built ships, it will not be the man who has invented and built airplanes, it will not be the men who have done all these things whose names will be written on the golden pages of this great epoch, but it will be, rightfully and honorably, the names of the boys who have made the supreme sacrifice on the battlefields of Flanders, that shall go down in the history and hearts of this great nation.

"I have been a fortunate man in my lifetime, in material things, health and friends, and one of the greatest pieces of good fortune in my business life was that I came to own and control one of the greatest ordnance works in the world, and that I could turn these works over for the use of our Government in the protection of this great country of ours, and I am proud of what it has accomplished, and I am sure you will not think I am boasting, but rather telling you something of interest in connection with this great industry at Bethlehem.

War Work of the Bethlehem Steel Company

"Since the beginning of the war the Bethlehem Steel Company has furnished the U. S. Navy with 60 per cent of all the steel for the ships and ammunition that they have received during the period of the war, and in addition to that it has furnished, besides the steel supplied to the Navy, one-quarter of all the steel for the merchant ships that have been built in the United States, and in addition to that we have furnished the Allies since the beginning of the war in Europe, and since the entry of the United States into the war, more than half of all the guns and munitions that went out of the United States or were furnished to our own nation. We have furnished to the Allies and to the U. S. Government more than 15,000 large field guns since the beginning of the war, or more than enough to furnish and arm all the soldiers of the United States sent to Europe. [Applause.]

"Now, I am sure that is a statement which will be of surprise to many of you people. I am proud of it, as proud of it as I could be of anything, because it was all in the nature of service to our country. I have reached the point in life, and all men reach it sooner or later, where there is nothing much left that brings real pleasure and excitement except the successful accomplishment of enterprising undertakings. And I do with pleasure and satisfaction dwell upon the work accomplished by our companies in this era that enabled the companies and the industries which I controlled to be so valuable in their service to this country at this time. In that I have been doubly fortunate. The next thing that I have been more than fortunate in, Mr. President, is to have had the approval of your Council and your members in the work which we have done. If it has reflected

Orville Wright

credit upon your Society and upon the members of the engineering profession, I am doubly happy and doubly grateful. [Applause.]

"Mr. Wright is not going to speak this evening, so the less he says, the more honor you can give him. From the days of Darius Green down to a recent period, people have written and talked about the flying machine, but the Wright Brothers were the men who actually built the first successful machine and to them belongs the credit. [Applause.] And I feel that it is a proud thing to be recognized in the same manner and at the same time with a man like Orville Wright.

"I thank you for your warm, kindly welcome, and appreciate more than I can tell you the honor you have bestowed upon me; indeed, I can say I appreciate it more than any honor that has ever come to me. I shall appreciate it. This certificate of Honorary Membership which you have given me shall have a proud place in my household, and, what is more important, an imperishable place in my heart." [Loud applause.]

President Main then formally conferred the Honorary Membership upon Mr. Orville Wright, whereupon the meeting adjourned.

BROADER OPPORTUNITIES FOR THE ENGINEER

Presidential Address, 1918

BY CHARLES T. MAIN, BOSTON, MASS.

WE have probably witnessed the end of hostilities in the greatest conflict that the world has ever experienced. The people of this country, after some hesitation, undertook to assist in finishing the task which the Allies had begun at whatever cost or however long it might take.

It is now a time for great rejoicing, but the signing of the armistice is not the signing of the peace treaty. What kind of a peace we are to have will depend upon the wisdom with which the multitude of questions connected with the restoration and redistribution of territory and international relations are settled. The war will not be won satisfactorily unless the purposes for which it was fought, from our viewpoint, are assured.

At this time it may be well to recall why we have been at war.

President Wilson said, some time ago, "To make the world safe for democracy."

Lloyd George said, "We are fighting for a just and lasting peace."

Ex-President Taft said, "It is the struggle that is essential to liberty and Christian civilization."

Premier Clemenceau said, "Our victory and the victory of our allies means the liberation of civilization and liberty of human conscience."

Many other reasons have been and may be given why we were at war, but brought down to its final analysis, it is that this nation and other nations may live with the maximum of safety and with the greatest amount of liberty.

Probably most of us have a vague knowledge of the many issues involved and an indefinite conception as to the effect of the war on the political, social and business conditions of the world, but we can surely predict that there will be a remolding of all these so that our country will be one of greater unity of purpose and desire with a more spiritual and less materialistic view of life and greater unselfishness in the service of our country and mankind.

[President Main then reviewed the war activities of the Society, a brief statement of which has already gone to the membership in the brochure entitled "In the Service," and outlined the work of the Council and Committees for the year, which will be placed on record in the Transactions.—EDITOR.]

A BROADER VISION

With this review of what the men in our profession are doing in connection with the war and the collateral problems, also having in view the quick expansion and development of the work along comparatively narrow and restricted lines into circles of almost unlimited possibilities, we have seen how we can and must free ourselves from our former provincial attitude into one of universal outlook.

If this can be accomplished at this particular time and for this particular occasion, why should we not now and in the future exert our influence and direct our energies toward matters of broader interest?

As a class engineers have been extremely modest in their relations with business and public affairs. This has been a natural condition largely due to the education and training which they have received. The education has been along rather narrow and restricted lines of scientific work, leaving out almost entirely the broader studies of literature, common law, economics, business methods and the humanities. After graduation there is usually not much opportunity for broadening out, for it is necessary for a man, if he expects to keep abreast with the development of his profession, to spend nearly all of his surplus energy in reading and studying along the very lines which he followed in school.

Notwitstanding this, it is wise to carry along a course of reading on broadening subjects and to have an interest in affairs which are wholly outside the scientific line of study, and to be identified with engineering and scientific societies in order to get the broadest outlook of life possible. It is for this reason, in order to get a broader aspect of life and acquire a taste for wider reading and study, that it is of advantage for a young man who is to follow some scientific pursuit to take an academic course before he takes his scientific course.

I realize the impracticability for many men to spend so much time at considerable expense in preparation for their life work, but it is almost essential that a man should very early in his career acquire some knowledge of business principles and should endeavor to broaden himself so as to be able to fill with fair satisfaction the position that properly belongs to him in his profession and in the world.

It should be the aim of the engineer to render the best possible service considered in a broad sense. It should be based on facts and not theories or suppositions, and upon scientific laws, which if properly applied will give satisfactory results. Nothing should be taken for granted, and the work or statements of others should be carefully checked before being adopted.

The success of a man will depend upon his ability to produce results in an expeditious manner, which shall be accurate, and in which good judgment has been used, so that the finished product, if it be a physical structure, will be adapted to the use to which it is to be put and shall have been accomplished at a reasonable expenditure. If it be a plan for action it shall be clear and concise and adaptable to the purpose for which it is intended.

He should be able to understand men and to know them. He should be willing to share his knowledge with his fellow-engineers and inasmuch as he will do this through the Society, or other similar means, his interests and outlook will broaden and the return to him will be multiplied. Integrity and perseverance in work and business and fairness and justice to all will in the long run count for more than brilliancy in attainments. Withal he must have a good stock of imagination and judgment, which is sometimes called "horse sense" in the application of fundamental principles to every day problems.

The true success of a man is not measured by the accummulation of money, but by the success of accomplishment of work which adds something to the general good for mankind and for the advancement of the profession.

In his annual address President Hollis said:

> In the changes that are coming the engineer can no longer dwell within his technical shell, and he must prepare himself to become a citizen of the world, upon whose shoulders great economic and social burdens are placed.

And Professor Kimball has said:

> If we have not at this moment a clear vision of whither we are tending, now is the time of all times to take stock of ourselves and to redirect our course, whether this course is in conformity with time-honored definitions or not. Change is not necessarily synonymous with progress, but there is no progress without change. No one can doubt that the scientist and the engineer are to be the most important industrial figures of the near future. If we are faithful to our duties we shall be of greater importance politically and socially, but to accomplish this we must broaden our vision and get about our business, which is the industrial organization of our country.

Let us then bestir ourselves and show a greater interest and a broader vision of the opportunities which now lie before us and which will increase in number and importance in the near future.

IN THE PROFESSION IN GENERAL

We are living in a period of profound importance to the whole world. The social and political conditions and the ideals of some and perhaps nearly all the nations are in a state of flux. To a large extent this may be said of our own country. This state of uncertainty and uneasiness has overtaken many men in our own profession, and it seems, therefore, necessary for us to consider with great care if it will not be necessary in the near future to readjust ourselves to the new conditions.

There is a tendency to form new organizations to accomplish new objects, or with the hope of doing some things that the present organizations are doing in a better way. This is unfortunate, as it is unwise and inefficient to have so many agencies endeavoring to accomplish the same result. Consolidation rather than segregation, up to proper limits, is desirable.

In local communities some plan should be arranged, which would vary in different places, for the local organizations to combine on matters of common interest. The plan, however, is of less importance than the action itself. If the local societies and members of the same are active in service to the profession and to the community, a plan will be evolved by which these interests and activities can be made effective.

ORGANIZATION

It was probably for this reason that the American Society of Civil Engineers, on June 18, 1918, created a Committee on Development and adopted resolutions creating the committee, a portion of which reads as follows:

The development and application of the sciences in recent decades have caused profound changes in the social and industrial relationships of all peoples.

Sociological and economic conditions are in a state of flux and are leading to new alinements of the elements of society.

These new conditions are affecting deeply the profession of engineering in its services to society, in its varied relationships to communities and nations, and in its internal organization.

A broad survey of the functions and purposes of the American Society of Civil Engineers is needed in order that an intelligent and effective readjustment may be accomplished so that the Society may take its proper place in the larger sphere of influence and usefulness now opening to the profession.

Resolved, that a Committee be created to report on the purposes, field of work, scope of activity and usefulness, organization and methods of work of the American Society of Civil Engineers, and to make recommendations concerning these matters.

The purpose and scope of the work of the committee is thus in part defined:

It is intended that the Committee on Development shall make a survey of the fields of usefulness which are or should be open to the Society, consider what functions may properly be assumed by the Society, define its purposes, formulate policies and methods of work to be recommended, and consider the needs in organization and constitution. This means taking stock and making plans. The resolutions contemplate an examination of present-day conditions and an outlook into the future. They involve considering the changing social and industrial relations of the times and the opportunities and responsibilities which devolve upon the Society and its membership. The relations of the Society to other societies and to the profession generally are also included. The outcome of the work of the Committee may be modifications in the activities, functions and methods of work, or in the emphasis in these matters, and possibly the addition of new ones.

Similar committees have been created by the American Institute of Electrical Engineers and proposed for the American Institute of Mining Engineers and our own Society. It is proposed that the various committees coöperate on subjects of common interest.

It is also suggested that it may be desirable to confer with representatives of local engineering societies throughout the country concerning the relations of such societies with the national societies.

The results of this work should be of great benefit to the whole profession in increasing solidarity, diminishing duplication of effort, more effective results in matters of common interest, a more representative opinion on subjects of general interest to the profession and public, the creation of a better feeling of fellowship and harmony and a much greater ability to assist in the inevitable evolution of industrial and social conditions which are soon to follow.

The advantages of unified command and action are most clearly demonstrated by the results obtained by the Allied armies under the supreme command of General Foch.

The Engineering Council is a step in the direction of coördinating the work which is of common interest to the profession. It has done much good work, but has not yet reached the maximum of its usefulness.

WITHIN OUR OWN SOCIETY

In anticipation of the work of our Committee on Aims and Organization, there may be mentioned some details of operation in the minor workings of the Society which might be broadened to advantage.

A plan might be developed for increasing the financial resources of the Society by contributions or legacies to a fund, the income of which could be devoted to research work and for prizes and premiums to the younger members for good work and for any other meritorious object which might present itself.

A plan should be developed which will make a working connection between the general meetings and the local meetings.

The coöperation between the Publication and the Local Sections Committees can be greatly developed if the individual members will see the great opportunity which these committees have already provided in the equal status of papers read before local and general meetings of the Society. The members can further help the Publication Committee in conjunction with the Meetings Committee by an earlier announcement of prospective papers, so that a general program for the ensuing year can be prepared during the summer and be submitted to all of the local sections and coöperation solicited in carrying such a program to completion.

During recent years the increased responsibility placed upon young men has increased the difficulties of the Membership Committee in the proper grading of applicants for membership. It may be that the Committee on Aims and Organization could well give consideration to this matter.

As already indicated, another profitable investigation which the Society can undertake is a still closer relation between the Research Committee and our other committees, including the Engineering Foundation, with the industries and with the scientific schools having facilities for research work. It has been suggested that the Society act as a clearing house between the research facilities of the universities and the research requirements of the industries.

Most of the broader aspects within the Society are in line of extending the usefulness of any one activity through the medium of coördinating it with some other activity. The whole organization is capable of being rounded out and planned so as to produce the maximum of teamwork.

CONSOLIDATION OF TECHNICAL SOCIETIES

In the Monthly Bulletin of the American Institute of Mining Engineers, March 1918, there appeared the following:

The vision dwells in the minds of many that ultimately these four great societies, lightening the emphasis they place upon their differences, may see the time when, for the solidarity of the profession, for their best interests, as well as for increase of their influence on the country at large, they may become one great national association of engineers. With the gain in power and prestige inevitably following such an aggregation, freedom for individual development may be achieved through divisions along the lines of technical interests, which might either follow the present four grand divisions or be more minutely subdivided.

An organization of this sort could and probably would be more strictly professional than any of the four have been hertofore, and through the prestige and power of its numbers could establish standards of ethical conduct for its members, violation of which would bring grave consequence.

This great vision is worthy of the most careful consideration and might be carried with safety to a point where the national societies would be gathered in under one executive head, without any one losing any vital portion of its individuality.

This would be a great step in advance and perhaps as far as we should go for some time to come.

STANDARDIZATION

There is now opening up to the profession the most promising opportunity of furthering the work of national and international standardization. It is the beginning of a real great international movement for standardization.

All of our own standards committees are working under the general direction of the Standardization Committee, the sole duty of which committee is to see that the work of the various committees shall be in harmony with the general scheme, but not to prepare standards for any particular purpose.

The American Engineering Standards Committee has been

created for the purpose of harmonizing the standards of the various branches of the profession, and it is about ready to function.

Upon invitation of the British Engineering Standards Association, this Society is acting as an informal correspondence committee in the United States.

NATIONAL DEVELOPMENTS IN WHICH THE PROFESSION CAN BE OF ASSISTANCE AND GUIDANCE

Although the military conditions with the Allies in Europe are satisfactory, there is a vast amount of work yet to be done in clearing up the whole situation, and our efforts should not be diminished until a satisfactory ending is reached.

It is now time to give careful consideration to the readjustment after the war, so that this country shall maintain its national and industrial integrity with due regard to our obligations to other countries. We were unprepared for war, which was a possibility, and we are unprepared for peace, which is a certainty.

The future will have problems and trials. The contests will not be of battle but of industry. The conquests will not be of territory or thrones but of markets.

Plans have been under consideration for some time in England, France and Germany for regaining the commerce lost during the war.

Upon our ability to resume our normal lines will depend to a large degree our prosperity at home and trade expansion abroad.

We were unprepared for war, and it has been a stupendous task to readjust our industries to a war basis. It will be no easy task to readjust ourselves for peace. In this readjustment our vision must extend beyond the state and nation out into the broad world.

"With courage we must face the future, confident that with a better understanding of our local and national problems, and with a closer and more systematic coöperation between the governing authorities and business institutions, continuing progress will be assured. These are not times for jealousies, prejudices and selfishness, but with a largeness of heart and bigness of vision we must unite in a common effort to help America achieve its manifest destiny."

Bills have already been presented to Congress which contemplate the creation of a Federal Commission on Reconstruction, the duties of which are far reaching. The Commission is to investigate and recommend to Congress what additional legislation or changes in legislation are desirable.

Under the Weeks' Bill the subjects are summarized as follows:

1 Problems affecting labor
2 Problems affecting capital and credit
3 Problems affecting public utilities
4 Problems resulting from the demobilization of our industrial and military war resources
5 Problems affecting our foreign trade
6 Problems affecting the continuance of existing industries and the establishment of new industries
7 Problems relating to agriculture
8 Problems affecting the adequate production and effective distribution of coal, gasoline, and other fuels
9 Problems relating to shipping, including shipyards, and especially in regard to the sale, continuance of ownership, or leasing of both yards and ships
10 Housing conditions and the disposition of houses constructed by the Government during the war
11 War legislation now on the statute books, with reference to its repeal, extension, or amendment
12 And in general all matters necessarily arising during the change from the activities of war to the pursuits of peace, including those that may be referred to it by the Senate or House of Representatives.

Under the Overman Bill the tasks named are as follows:

a The financing, regulation, control, and development of the merchant marine
b The development, financing, expansion, and direction of foreign trade
c The reorganization, financing, and readjustment of industries engaged in war work by way of reconverting them to normal production
d Technical education and industrial research as a means of developing and strengthening industry
e The redistribution and employment of labor in agricultural and industrial pursuits and the problems of labor growing out of demobilization
f The supply, distribution, and availability of raw materials and foodstuffs
g The conservation and development of national resources
h Inland transportation by rail and water
i The reorganiation of government departments, bureaus, commissions or offices with a view to putting the Government on an economical and efficient peace basis
k The consolidation of such acts and parts of acts of Congress which relate to the same subject-matter, but which now appear at various places in the statutes.

Nearly all of the problems suggested above are directly or indirectly engineering problems. The framing of laws would be greatly facilitated if the advice of the engineers were made available in furnishing many of the physical and technical facts upon which they should be based.

Nearly all of the problems of a municipality and largely of the state and nation are engineering in their nature and it should be the duty of all engineers to take an active interest in the conduct of public affairs in so far as the opportunity offers. It is always possible in the smaller way in the community and the opportunity will broaden if a man shows his ability and interest into fields of wider scope.

Our assistance will be needed now more than ever, for the tendency of the times is toward socialism and government ownership or control of all facilities which are used by the public. The arm of federal authority is reaching further and further into our personal life and affairs. We are moving rapidly in the transfer of authority from those who have a personal interest in its successful exercise to those who have only political advantage to gain.

This Society, other societies and Engineering Council are already working on some of the problems. We are not concerned with all of them at present, but should be soon. We should begin to look upon all of them with a broader vision, and should take a more active and helpful attitude toward public affairs and industrial relations which we have heretofore considered beyond the scope of our work.

One of the reasons why we have not accomplished more during the war has been the difficulty of making a definite connection or association with the military operations of the Government. It has been suggested that some arrangement might be made between the Government and Engineering Council, by which all kinds of engineering and kindred problems could be submitted to the Council. It is also suggested that Engineering Council offer its services to every Congressional Committee having problems of an engineering nature to report upon. If it could be brought about that the engineers would be invited to assist, it would be a very satisfactory arrangement.

There will probably be many commissions established on which an engineer member would be of great assistance in transmitting to the other members such technical information as they would need to understand the fundamentals of the technical portion of the problem and in directing the line of effort for obtaining the technical data required.

Before we can make a successful connection, however, we must have enough knowledge of their problems and enough imagination to be able to suggest along what lines we can be of assistance.

While we are holding our convention, the National Council of the Chamber of Commerce of the United States is being held in Atlantic City, for the purpose of formulating plans for reconstruction of business.

READJUSTMENT OF LABOR AND TREATMENT OF EMPLOYEES

Probably the greatest problem before the nation is the redistribution and readjustment of labor.

The following is quoted from a bulletin of the Chamber of Commerce of the United States with reference to "A New Service."

War conditions impose upon business and industry problems of great difficulty and unusualness, requiring thought and action.

The conditions of shortage of labor, the great pressure of demand for products, the shrinkage in the purchasing value of the wage, and the spread of democratic ideas have created the necessity for labor administration all along the line from the Government down to the small private manufacturers.

These developments have all come about so rapidly that their implications and necessary consequences have not been realized. The most far-sighted and intelligent opinion sees in these events the beginnings of revolutionary changes in industrial relations which will eventuate in a strong federal labor administration to control this vast machinery.

The employers have an unlimited opportunity at the very beginning to participate in this administration. The danger of failure is greatest from indifference and lack of understanding among employers, from an unwillingness or incapacity to learn coöperative in place of competitive methods.

The War Service Committees, under the direction of the Chamber, are working out adjustments called for by the War Industries Board as regards materials, fuel and transportation. The Committee on Industrial Relations has undertaken similarly to join with the War Labor Administration in its task of procuring the maximum utilization of our labor resources.

To investigate all experiments and developments in industrial relations both in this country and abroad and to place before the membership the results of such research. To assist the constituency of the Chamber in bettering the relationship between employer and employee by making available the records of the best experience and practice concerning wage and hours adjustment; methods of handling grievances and discipline, industrial service (improving the working and living conditions of employees and their families, housing, medical service, recreation, insurance, accident prevention, etc.); dealing with labor organizations; utilizing mediation and arbitration in disputes; securing the coöperation of employees in raising standards of efficiency; improved methods of employment management, hiring, transfer and dismissal, fitting the men to the job.

The permanent results of the activities of this committee will be educational. If successful, it will have created in the minds of employers a rational attitude, supported by facts and information, concerning the relations between themselves and those whose interests they are administering. The wage earner is just as dependent upon the intelligent and successful administration of enterprise as is the business upon the loyal and efficient service of the employees. The war has given an impetus toward democratic methods of administration both in public and private enterprise. Industrial administration must adapt itself to those conditions and conform to the prevailing ideas of the time or find itself in antagonistic relationships with all interests with whom it must deal. The employer must conceive himself to be a trustee of the interests of all involved in his enterprise and see that these interests are properly represented, lest he be confronted with opposition handicapping all his efforts. These administrative difficulties are not wholly the product of war nor will they disappear at the close of the war; indeed, it is more likely the industrial problems will increase in complexity with the coming of peace.

These quotations have been made because they describe the problems and responsibilities which are ours.

This vast and wonderful industrial organization with which we are living and struggling, is the growth of the last century. Its growth has been so rapid that neither the employer nor employee as a whole has been able to see with clear vision a just solution of the many problems of relationship one to the other. For this reason there have been misunderstandings and struggles of great intensity with the tendency of further separating the two parties, whose interests are largely in common. Protective organizations have been formed principally by the employees, whose object is primarily the betterment of the condition of the working people. Just so long as these organizations representing the employer and employee are managed and conducted for the general welfare of the community as a whole, they may be of service to the country, but when their affairs are conducted in a manner prejudicial to the interests of the community, they should be curbed.

Organized labor has its plans for the present and after-the-war period, which from all indications are very far reaching. The industries may have some plans, but they are not much in evidence.

The real issue is whether the genius of American individual enterprise is to be free, with due regard for the opportunity and welfare of all the people. The responsibility of guiding the republic rests upon such thinking men and men of experience as are members of this Society.

Many of our members are now vitally interested as employees with these great relationship problems. Some of those who are now employees will later be advanced to the position of employer, and knowledge of these problems will better fit them for advancement. By treating this matter on a very broad basis far greater progress will be made toward the establishment of satisfactory conditions than by settling down into a condition of stubbornness and refusing to look the facts in the face and endeavoring to operate under conditions which may be wholly in opposition to preconceived ideas of what is proper.

We had our labor problems before the war, they will be more complex after the war, on account of the readjustment which must take place. The bulk of the men who have gone into the service will return, many women have gone into the industries and into work heretofore done by men only, and in many instances they have surpassed all expectations. The policy to be followed by foreign countries to regain their lost or impaired commerce will have a bearing on our problems.

These and many other questions will tend to make this problem more complex.

It is hoped that as a result of this war there may be greater efficiency in industry, a better use of the productive potentialities of men and materials, more perfect business organizations, elimination of waste, the doing away with many non-essentials and extravagances, but no amount of organization, standardization and control will be of any consequence in increasing production, unless the workmen concerned will put forth the requisite effort, and unless labor stands for increased rather than decreased production, this country is on the way to industrial ruin.

As business men, employees and employers, we can individually bring influence to bear toward a fairly just and satisfactory treatment and solution of these problems, and as professional men, without prejudice, we should be qualified to discuss with impartiality these problems and act as arbiters in the settlement of many questions of doubt.

The real and great problem extends far beyond the adjustment after the war. It means the development of relationships which will enable all of our citizens to live and work together under conditions which will produce the maximum amount of happiness and contentment possible for years to come.

It is perhaps nothing more than a dream of De Constant, the realization of which is far in the future, but if we all think and work along lines which will lead up to its accomplishment, it will be aproached as years go by.

"The spirit of domination will lose more and more its prestige, while a policy of justice and conciliation will impose itself as being the only one corresponding to the aspirations and progress of humanity." (De Constant's America and Her Problems.)

EDUCATION

Another one of the most important problems in which the Society could be of great assistance is education.

The Council of this Society has been acting upon the assumption that the war may last for several years and that it would be a calamity to withdraw from our colleges and scientific schools all of the raw material for immediate use in the field, unless the crisis becomes more acute than it has yet been, but that this material should be retained for training in order to supply the loss of men which will occur if the war should go on for some years and the increased need of men trained in the sciences and industries. It petitioned Congress to enact such legislation as would enable drafted men to be assigned to special study or work and not to be called into active service until they have been fitted for the work which they can do best, unless it is absolutely necessary to have immediately a vast amount of man power in the field.

The resolutions called for "Maintaining unimpaired the engineering strength of the nation for the prosecution of military operations and for the support of the sustaining industries."

"It urges that schools of engineering as the principal sources of this training be regarded as closely allied in the material purpose with military and naval schools of the nation."

Copies of the resolutions were sent to the Secretary of War and the Provost Marshal.

A committee was appointed to ascertain the availability of technical schools and laboratories and what other opportunities there may be for industrial training.

Resolutions were passed and sent to the Secretary of War, protesting against the diversion of engineering schools from their primary function of advanced technical education, because of the persistent pressure for a training of technicians for the war.

As a result of these resolutions the Secretary of War appointed a Committee on Education and Special Training. Another result was the nationalization of scientific schools and colleges.

Committees of various kinds have been created for directing the work of special education and training for the war, but very little actual work has been done with reference to education after the war.

Bills have been passed in Congress making substantial sums available for vocational education upon joint action of the states with an equal appropriation of the allotment to the state.

If the manufacturers of the country desire to utilize this fund, it is up to them to secure the assistance of the state; otherwise the fund or that apportionment for the state not taking advantage of the opportunity will be turned back into the Treasury.

The Federal Board for Vocational Education has undertaken the work of reëducating disabled soldiers and sailors. It has made the following statement:

In dealing with the disabled man, the Board expects to treat him throughout as a civilian needing advice and assistance, to approve his choice of occupation, unless, after careful investigation, sound opinion shows it to be in the end not advisable to train him to meet the needs of the occupation he has selected, to urge him to make the most of his opportunity to overcome his handicap by taking thoroughgoing instructions, to help him to secure desirable permanent employment, and to keep in close touch with him after he goes to work.

The manufacturer should be greatly interested in this work of rehabilitation and should aid the Board in every possible way. The War Department expects to train a large number before the year is out.

These reëducated men, made proficient in some trade or operation suited to their remaining capabilities, are going to constitute the most available source of skilled labor for some time to come. They will probably be the most dependable labor in the inevitable period of unrest and readjustment after the demobilization of the armies, when the country is settling back into a normal condition again. These reëducated men will form a core around which the newer labor can center. The manufacturer who has the foresight to make liberal use of these trained men is going to have an immeasurable advantage over his competitor who trusts to luck to get the help he needs out of the disbanding armies.

Very little, other than that already described, has been done with reference to education after the war. This work should be begun immediaately. Plans should be made for reconverting the scientific schools and colleges back to their peace program.

Many of our members are engaged in manufacturing and many in teaching. We have committees on Industrial and Vocational Training. There should be coöperation between the industrial plants and the schools. We can be of great assistance in the practical redevelopment of the educational systems and in the relationship between the schools and the industries, in the rehabilitation of crippled soldiers and industrial workers and the teaching of the blind, in an endeavor that every man shall have an opportunity to earn a living in a way that will carry with it some deegree of happiness.

A portion of a recent editorial in London *Engineering* reads as follows:

Education in its broader sense should have as its main object the training of the mind towards the achievement of greater happiness and this can only be got by developing the thinking faculty so that a better perspective of life can be obtained. Thereon rests the hope for greater amity between employer and worker and a higher realization of the duties of citizenship.

The recent report by Dr. Charles R. Mann, entitled A Study of Engineering Education, prepared for the joint committee on engineering education of the National Engineering Societies, Bulletin No. 11 of the Carnegie Foundation for the Advancement of Teaching, should be read by everyone who is interested in engineering education.

The report should be of great assistance in the reorganization period. I am in accord with many of the recommendations and conclusions, particularly those mentioned in the introduction by the Joint Committee on Engineering Education, which reads as follows:

Other significant characteristics of the report are found in the discussions of the general failure to recognize such factors as "values and cost," the importance of teaching technical subjects so as to develop character, the necessity for laboratory and industrial training throughout the courses, and the use of good English.

Another point emphasized, and one of deep importance, is that of the reorganization of curricula which are commonly acknowledged to be much congested, and which it is stated will continue, "as long as departments are allowed to act as sole arbiters of the content of the courses." Plans are offered for developing particular types of curricula suited to the environment of each school.

Emphasis is also given to the necessity for a broader training in the fundamentals of science as an equipment for all engineers and forming a sort of "common core" to every curriculum. With this broad training in the first and second years the student is expected to develop some natural leaning toward a specialty, and then will follow vocational guidance in the later stages of his education.

The scale for measuring the success or failure to provide proper training for engineers has been created by the practicing engineers. That scale is the improvement of character, resourcefulness, judgment, efficiency, understanding of men, and last of all, technique, as shown by students.

With the conversion of the schools and colleges to war work, intensive study became necessary. Everything except the essentials was eliminated, with more hours of work per year.

It would be a good thing if in the reorganization period much of the specialization work can be eliminated and thus a shorter time be required for college work for the bulk of the students, and if a greater portion of the year could be devoted to work, thus using the educational plants to a higher degree of efficiency, that is, with a higher load curve.

In educational, as well as in other lines of endeavor, if we have not learned a lesson of conservation of time and effort, we shall have missed some of the benefits which it is hoped will be derived from the war.

CONSERVATION

Next in order of importance to labor in the industries is the ability to procure raw materials in sufficient quantities and at reasonable prices. I will not dwell upon this subject, but will pass to the question of power, with which we are more closely identified, and which affects directly the bulk of our people.

Many of our members have been assisting in the conservation of fuel by serving on committees or individually in attempting to assist the various fuel administrators in the country, or on committees or commissions established for the proper development and utilization of our water resources.

Considerable savings in fuel have been effected recently by more careful attention to the burning of fuel and the use of steam in prime movers, but much more has been saved in simple commonplace and common-sense ways of preventing the waste of heat and power after they have been delivered from the boiler and engine rooms to the various rooms and departments about the plant.

An example of the sort of work which the engineers can accomplish in fuel conservation is that done by the Advisory Engineering Committee to the Fuel Administrator of Massachusetts, all of the members of which, with one exception, are members of this Society, in the assisting in the establishment in every plant and building using steam for heating and power, of a fuel and power committee within its own organization, whose duties are:

1 To see that fuel is burned economically and to prevent waste of steam and power
2 To initiate and carry on a campaign of education among fuel and power users
3 To distribute among users, engineers and firemen an outline of the items of loss, and to supply information for the purpose of saving fuel and power
4 To assist local fuel committees in enforcing economies in wasteful plants

5 To enlist the services of engineers in carrying out this program.

Similar work has been done by other committees in many states.

During this work, however, we have been endeavoring to get the best results with the existing facilities. We should now be studying the vaster problems which are to be undertaken in the future for the conservation of our natural resources.

The generation and transmission of energy by electricity has changed the conditions so radically in the last few years as to require the most careful study of the proper place and manner of the production of power for all purposes.

The problem of power supply is very intimately connected with the railroad and transportation problems, and a study of one involves the study of both.

There have been very serious delays in the transportation of materials and supplies, and one of the principal reasons for coal shortage last winter was a lack of sufficient transportation facilities. It is stated that about one-quarter of all the coal used and transported is for the use of the railroads, and another large portion is required for manufacturing, lighting and power. Some of this necessarily must be used at the plants for heating and manufacturing purposes.

Much of this traffic could be eliminated by the establishment of large steam-generating plants located as near the coal mines as conditions will permit, and on tide water, where coal and oil could be brought in by vessels, by the development of hydroelectric powers, which are within reasonable distance of the market, and by the electrification of the railroads, with great trunk connecting and transmission lines. Incidentally with the further development of hydro-electric power is the saving in labor required for the mining, transportation and burning of coal.

Savings can be made by more careful study and use of the waste heat of furnaces in the form of gas for the production of power, and from steam turbines and engines by the use of steam and warm water for heating and manufacturing purposes.

Further conservation of power and fuel can be made by interconnecting transmission line between the hydroelectric companies so that the greatest possible use could be made under the varying conditions of flow of the steam at the different developments.

Still further saving of fuel can be made by the redevelopment of many of the older water-power plants, which contain inefficient wheels in efficient settings, and it may be possible in many cases to increase the capacity of the plant so as to use all of the water for a longer period of the year and waste water for a shorter period.

The conservation of flood waters, now wasting, by the construction of storage reservoirs, is receiving greater consideration. Special commissions have been appointed in some states for the study of this question, but as yet no great progress has been made so far as reservoirs for power are concerned. Most of the reservoirs for power already constructed have been built by private interests and by agreements among parties deriving benefit from such reservoirs.

The four chief reasons why this sort of development has not proceeded more rapidly are that the development expense and yearly charges of many would be so great that the returns would be insufficient to offset them and show a fair return on the investment, the inability of parties at interest to agree on some working plan for sharing the expense, that legislation has been of a discouraging nature, and because in the past all values have been measured in dollars and cents, as applied to the cost of power with not much consideration to conservation or the uses to which the power was put.

The expense of such large developments at the mouth of the mines and at tidewater, and of the development of some of the hydroelectric powers, may be too great for private interests to undertake. The uncertainties and restrictions imposed have been such as to prevent the development of some of the possible water powers. More liberal legislation is needed to encourage these undertakings in many of which the margin of profit is small and doubtful. Congress has now under consideration a water-power bill which it is hoped will encourage developments.

From now on we should consider the value of development with a broader conception of not only the net comparative cost of power, as produced by one means or another, but also in connection with the desirability of having another instrument by which the full production is assured, the value of the product being far greater in most cases than the cost of power, and with the desire to conserve our natural resources, and with a view in times of shortage, of assisting in the general stabilization of business.

It is not conceivable, however, that the business men will be willing to make expenditures for anything that will not improve their own property or conditions, and any excess expenditure required for conservation for the benefit of the general public must be met from the treasury of the public. It is conceivable and proper, however, that the individual should take a broader view of the benefits to be derived from expenditures for his own benefit.

The basis for valuations of all properties or undertakings while subject to discussion and variation of opinion, was fairly recognized three or four years ago. Estimates of initial cost, cost of operation, gross and net income were made to determine the value on a basis of dollars and cents.

During a period of war, costs and values were increased enormously, and values are not measured in dollars but in time, necessity and quick availability for the purpose of ultimately saving life and vaster amounts of property and even the safety of the nation.

After the war there must be a readjustment of values, and with this there should be a broader conception of values than that measured wholly in net returns of money.

The above outline of possible methods which might be used for the conservation of fuel is made for the purpose of describing in a general way the broader view which should be taken of this particular subject, and as an example of how the many other problems which have been summarized earlier should be attacked, not as a problem by itself to be decided in terms of money as applied directly to that particular problem, but with careful consideration of the broader bearing upon the greatest good for the community or country. Such broad consideration as this will necessitate a remolding of our former circumscribed conceptions, a broadening of our imagination and the weighing of the effect of action and consequences in the broadest and most liberal manner.

As a people we should readjust our methods of life, getting down more nearly to the fundamentals, eliminating many extravagances and wastes in our private method of living, in our local, state and national governments, in education, in the industries and in all of our activities, so that we may not rob future generations of the heritage which is rightfully theirs, and so that we, ourselves, may by elimination of many cumbersome things, get a better perspective of what is necessary and right and live with a better conception of the real things of value on this earth. If we shall not have learned a lesson which will enable us to do so, a part of our suffering will have been in vain.

In closing I desire to quote from an article prepared by Hon. Joseph I. France, which is applicable to the present time and during the period of reconstruction:

"Scholars and members of these great academies, officials of states and nations, men in the armies, men and women in all our industries and at home, must catch a vision of this process and of this plan and strike strong, increasing, shaping, fabricating blows in order that in these fires American may be welded into that new and more nearly perfect symmetry and unity which will assure to each and to all the utmost safety and the highest liberty.

"In America the new temple of liberty is not yet builded, but it is in the building, and it is for us, for each living American, an hour of opportunity and of destiny, in which we all must rededicate ourselves unreserved to sacrifice, to toil and to unwearying service until the nobler and more lofty fane is fully complete."

AIMS AND ORGANIZATION OF THE SOCIETY

Progress Report of the New Committee on Aims and Organization of the Society, Presented by Mr. L. C. Marburg, Chairman, at the Thirty-ninth Annual Meeting

THE Committee on Aims and Organization convened for its initial meeting on Monday, December 2, when the following were present: Representing the Local Sections—Earl F. Scott, Atlanta; Charles H. Repath, Los Angeles; C. H. Bierbaum, Buffalo; E. S. Carman, Cleveland; Ralph Collamore, Detroit; A. G. Duncan, Boston; John T. Faig, Cincinnati; Howard Gassman, Birmingham; Howard Gustafson, St. Louis; J. L. Henning, New Orleans; C. E. Lord, Chicago; L. V. Ludy, Indianapolis; T. C. McBride, Philadelphia; G. K. Parsons, New York; H. P. Fairfield, Worcester; C. M. Spalding, Erie; L. H. Strothman, Milwaukee; C. W. Tubby, Minnesota; A. E. Walden, Baltimore, and Robert Sibley, San Francisco. Members at Large—L. C. Marburg, Sumner B. Ely, W. F. M. Goss, L. P. Alford, Dexter S. Kimball, F. R. Low and James Hartness.

The program reproduced in the center of the page was discussed, and the proceedings of the meeting are described in the following report by Mr. L. C. Marburg, Chairman, which was delivered at the business meeting of the Society, held in the Auditorium of the Engineering Societies Building on December 4:

Committee on Aims and Organization

PROGRAM OF FIRST MEETING

December 2 to 4, 1918

A. RELATIONS OF THE MECHANICAL ENGINEER TO HIS WORK.

Note—Here should be classed all activities of the Society to be undertaken for the benefit of mechanical engineers, either individually or as a group.

1 Discussion, Recording and Dissemination of the Progress in the Art of Mechanical Engineering and Allied Sciences.
2 Conducting and Assisting Research.
3 Standardization.
4 Industrial Management.
5 Education and Special Training.
6 Legislation and Jurisdiction affecting Engineering Profession.
7 Engineering Societies' Employment Office.
8 Code of Ethics.
9 Other subjects that suggest themselves.

B. RELATIONS OF THE (MECHANICAL) ENGINEER TO THE COMMUNITY.

Note—These relations identical in principle with the relations of other engineers to the community. Here should be discussed the engineering profession's opportunity to render service to the community.

Ba. IN CONNECTION WITH LEGISLATION.
1 Protection of Health, Life and Comfort.
2 Production, Distribution and Sale of Commodities and Service (exclusive of "Public Service").
3 Industries, Utilities and Natural Resources, Owned or Controlled by Communities.
4 Legislative Changes to Secure for the Engineer Influence in Public Affairs.
5 Other subjects that suggest themselves.

Bb. IN CONNECTION WITH ADMINISTRATION.
1 Placing Engineers in Public Positions requiring Engineering Training.
2 Coöperation with Engineers in Public Positions.
3 Creation of Special Organizations in Times of Emergency.
4 Other subjects that suggest themselves.

Bc. IN CONNECTION WITH JURISDICTION.
1 Assistance in Enforcing Legislation as mentioned under *Ba*, by obtaining action against violators and helping in the securement of expert testimony.
2 Assistance in the Settlement of Disputes.
3 Other subjects that suggest themselves.

Bd. IN CONNECTION WITH PUBLIC OPINION.

C. RELATIONS OF THE MECHANICAL ENGINEER TO OTHER ENGINEERS.

Note—Under this heading should be discussed the organization of the Engineering Profession.

1 Advantages of Closer Relations.
2 Form of Closer Relations (Organization).
3 Internal Organization of the A. S. M. E.
4 Other subjects that suggest themselves.

PROGRESS REPORT OF THE COMMITTEE

At our Spring Meeting at Worcester last May, a resolution was passed expressing the opinion that the activities of The American Society of Mechanical Engineers, as demonstrated in meetings and literature, were not in harmony with the aims and purposes of the Society as expressed in the Constitution, and suggesting to the Council to take some action to have the aims and purposes of the Society restated.

Closely upon this resolution at Worcester followed the memorable resolutions of the American Society of Civil Engineers, passed by the Board of Direction on June 18 of this year, creating a Committee on Development. Extremely well they state in their preamble the considerations which make a broad survey of aims and purposes advisable. Let me quote:

> The development and application of the sciences in recent decades have caused profound changes in the social and industrial relationships of all peoples.
>
> The Engineer has been a leader in this progress.
>
> Sociological and economic conditions are in a state of flux and leading to new alinements of the elements of society.
>
> These new conditions are affecting deeply the profession of engineering in its services to society, in its varied relationships to communities and nations, and in its internal organization.

These are days of change; indeed, days of revolution. Overwhelming, unbelievable are the transformations taking place. Empires have fallen almost between two succeeding editions of the same afternoon paper. Only a few years ago individualism

reigned supreme in the business and life of our country; these last few months we have had our breakfasts and our dinners regulated; have been told when we may drive our automobiles, and what not. And then our railroads, our telephones and telegraphs, our express companies are operated by our Government. True enough, it has all happened under the exigencies of war; but who will say how far we will go back in times of peace? Revolutions we have witnessed and are witnessing; but not only political, economic and social revolutions; revolution even more in our habits of thought and our ideas as to the necessity of preserving the past. While we are casting off long-cherished methods of conducting the country's everyday life, we are challenging conventional ideas and preconceptions, we doubt theories held almost sacred heretofore, and we freely question not only the views of others but our own. A momentum has been acquired by this habit of thought which will carry us, if we but guide it wisely, far into the promised land of economic efficiency and social justice; not to the millennium, I am sure, but to institutions based on modern thought and present-day development instead of on conditions and beliefs a century ago.

What Is the Engineer's Part?

But dreams do not come true unless we work for them. What, then, is the engineer's part in carrying this dream to reality? What is and what should be the position of the engineer today? Look about you. You see a world on which, during the past two generations, the engineering profession has placed a stamp more marked than any other group of men, but in the management of which it plays a rather secondary part. There is an abundance of public work and public business which is of a nature familiar to the engineer and similar to the tasks he performs in his everyday activity. Much of this public work is done in such a way that no private industry or institution could copy it without fiasco, financially and otherwise.

Some of these thoughts gave impulse to the creation of the Committee on Development and to the creation of our own committee. The formation of these committees is interesting; they consist of one member from each Section and of several members at large appointed by the President. With our committee a temporary executive committee was appointed by the President to handle all business previous to the first sessions of the general committee and to prepare a program. A meeting had been planned for the last days in October in connection with the Indianapolis Mid-Western Sections Meeting, but this had to be postponed on account of the influenza epidemic. So, Monday and Tuesday of this week we had our first meetings, and no doubt you wish to know what we have accomplished. We had with us representatives from almost all the Sections. Our work, of course, has reached no final stage, but we have passed two resolutions, which I am instructed to present to you. The first one reads as follows:

Broader Scope for Society Recommended

WHEREAS, The engineer has been in the past too closely concerned with the purely technical side of his work, and as a consequence has not, in general, occupied a position of influence in local and national affairs, and

WHEREAS, By education and training he is preëminently fitted to deal with many matters of great importance in public and private life, and

WHEREAS, The services of the engineer in such matters will be welcome if he will qualify in this broader sense, be it therefore

RESOLVED, That to this end the scope of The American Society of Mechanical Engineers should be broadened to give full recognition and encouragement to the individual engineer to accept the opportunities offered in today's widening activities, such as:

1 In his relations to his own work
2 In his relations to the community
3 In his relations to other engineers.

These resolutions express the thought that opportunities await the engineer in public life, and that he will be welcome to render service to the community as soon as he will fully qualify for it. And these resolutions recommend that The American Society of Mechanical Engineers extend the scope of its activities, so as to aid its members in their preparation for the broader activities now presenting themselves. It is a resolution of a most fundamental character; it suggests that if the engineer today does not hold the position in public life which he believes he is entitled to, the fault is largely with himself.

There is this continual complaint that engineers are not receiving what is due them. All sorts of panaceas are proposed to remedy this situation. One thinks licensing of engineers is what we need, another one believes in advertising our achievements; most are looking for the trouble outside the family and not within. The resolution expresses a different attitude. It is necessary to realize the shortcomings of many, and perhaps of most, of us. They are largely the result of the character of engineering work. Most engineers are little in contact with the public in their daily occupation. Their work most frequently requires great concentration, and quite often must be kept secret. Engineers, therefore, do not come much in contact with the people the way the lawyers do, for instance, and their relations, except with other engineers, are mostly with superior or subordinate. Furthermore, the engineer's whole training is largely mathematical and educates him to a step-by-step reasoning; it rather curbs imagination—so necessary for big things.

Publication Policy Endorsed

The other resolution the Committee wishes to present to you today deals with the literature of our Society as a means of broadening the scope of our activities. It also states that the Committee on Aims and Organization is vitally interested in this literature as a means of establishing closer contact with the membership at large and of securing a fuller expression of its sentiment. The resolution reads as follows:

WHEREAS, One immediate and powerful means to broaden the scope of The American Society of Mechanical Engineers would be the strengthening of its literature, and

WHEREAS, It is vitally necessary to establish a closer point of contact between the individual member and the Committee on Aims and Organization, in order that the committee may better express the sentiment of the membership at large, therefore be it

RESOLVED, That the Committee on Aims and Organization supports the recommendation of the Publication Committee regarding the increase in the frequency of issue of THE JOURNAL in its contemplated improved form as a matter upon which immediate action is necessary.

The foregoing resolutions, if followed, will involve certain changes in the organization of The American Society of Mechanical Engineers which will require more careful consideration, and the Committee wishes me to say that on this subject, as on many other subjects, it is not ready to make any suggestions at this time.

On the preliminary program, discussed at the Committee meeting and here reproduced, there are many subjects of interest to us. Additional ones should, without doubt, be added. These subjects are intended just as a hook to hang a coat on. They are to serve as guides in our discussions, and they have helped us in the formation of three large sub-committees for the consideration of the main subjects under captions A, B and C. These committees will take up these broad topics, will discuss them with such members of our Society as have already devoted a great deal of thought to some of the individual subjects like standardization, research and others, and will report to the general committee at its next meeting. They will outline their suggestions as to a broadening of various fields and as to entirely new activities. The Committee members will discuss most topics with their respective Sections, and in this manner help to crystallize the views of most of our membership. The Committee hopes that suggestions will be sent freely for its guidance.

You may feel that the Committee has not produced much as a result of two days' sessions. But consider this. The Committee must approach all subjects and all views presented with an open mind. It surely must not rush into the formulation of resolutions except on some most fundamental points, for the discussion should remain in a state of flux. Our views on some of the great subjects here before us may be different a few months hence from what they are today.

May I, then, be permitted to express a few thoughts that have passed through the minds of some of us during the last few days or in connection with the preparation of the preliminary program. They are thoughts and ideas that have not taken definite form as yet, but they will occupy us much in the months to come. In doing this I am speaking not for the Committee but on my own responsibility.

Let me say that neither myself nor any one with whom I have talked so far has advanced a finished program for our Society's activity or the profession's organization. But the general belief is that a free and nation-wide discussion will lead to a crystallization of ideas and to a plan of liberal coöperation between all engineering organizations.

Type of Organization Wanted

Our Committee is called the Committee on Aims and Organization, and the preliminary program placed before our Committee, as you will note from the copies here distributed, follows this name. What, then, should be our aims? what organization will be necessary to carry them out? Let us consider for a moment along broad lines what our aims should be. As individual engineers we wish assistance in our work; we wish to help each other and our profession in many matters affecting mainly our group, rather than the community at large. And in these activities we are joining hands with other men of similar education and similar training as ourselves. But there are other aims, may I call them public aims; the desire to render service to the community in matters in which our engineering training makes us essentially fit to have an opinion and a worth-while judgment. In any such activity we must join a larger group than in our professional activities if we expect success. Just how large the group should be I am not prepared to say. But just remember this: If the group looking for public influence consists of fifty thousand highly educated men, one hundred thousand or two hundred thousand will remain outside, all familiar with the same problems and vitally interested in the same decisions which affect the fifty thousand engineers. These hundred thousand or two hundred thousand men will have to be convinced inside or outside our group. But will they be convinced by our arguments more readily when excluded from our councils? The world has talked democracy for four long years. Most everybody has done some thinking as to what this ideal really is for which so many have died. Give democracy a trial. If those who have had the benefits of education are not able to lead the economic group of which they are a part, if they cannot convince the men who have a certain understanding for the special problems to be considered, how then are they to convince the whole community? And if we do prevail in one group, we shall have a powerful array of men on our side to spread the gospel among all levels of society.

Organization of the engineering profession, then, must deal with two separate groups of aims and with two separate groups of partners with whom we wish to join. When looking at the problem in this manner, it becomes at once apparent that possibly two entirely different types of organization may be wanted, one for professional work and one for public activities. Let us follow up this thought and let us see how far existing organizations may be used. When we aim at technical discussions, when we wish to further research, standardization, the art of management, and so forth, when we wish to bring the engineers together, according to their main interests, we can, in principle, hardly much improve upon the grouping we now find in our national societies. Of course, we always see occasion for improvement here or there in the methods we are following. We need more local sections, for example, for the reason that not all members can come to headquarters to participate in technical discussions. Sections should be encouraged to coöperate with other local sections and to affiliate with local engineering societies. This has so successfully been done in several localities that it should be further encouraged. But, above all, more coöperation is needed among the national societies themselves. Just in what manner this should be done is an open question; whether by bringing all national societies together into one society or simply by closer and closer contact between them and more joint committee work, it really matters little. But more coöperation in some form is the gospel we should preach.

A Way to Get Representation

As stated before, I am far from having a ready-made program to offer, and, of course, the Committee has not as yet reached any final conclusion. But may I suggest that successful activity in public matters on the part of engineers has so far been practically limited to local all-inclusive engineering societies. I know that I am not expressing the views of all the members of the Committee when I say that the local all-inclusive engineering society is the best agent through which the engineer can render public service. But it seems so to me; first, because there are many more local problems that interest him as engineer than state or national problems; and, furthermore, because the local all-inclusive engineering unit lends itself most readily as the basis of state and national organizations for public engineering service, organizations which must adapt themselves to the existing organization of our country so that mobilization will easily be possible in cities, states and nation. There seems to be no reason why a number of such local units, located in one state, cannot appoint delegates to a state body consisting of such delegates, and thus secure a fair representation to the engineering group of the state in question. We have seen a development in this direction in Ohio. And why should we not go further and have representatives of all such local bodies joined as a national body representative of the country's engineering group. In other words, the local unit would be the basis of our whole structure for public service, as opposed to our organizations for professional aims, formed on a national basis and along lines of specialization. The local unit would be all-inclusive and would act direct in local matters while acting through delegates and representative bodies in state and national affairs. And the national societies should be represented on the national body.

No matter, however, what means may be adopted as best suited, what should be emphasized is this: The issue is not individual activity but group activity. The issue is not, as frequently expressed, that, of course, the engineer must be a good citizen like everybody else; it is not a question of voting the Republican or Democratic ticket. The division must be a different one. It is a question of making available to the community the combined training and combined experience of the group of engineers, just as I hope other groups of men will do in the days to come.

Our Duty to Understand Labor

And in the consideration of the problems that are before us, may I suggest this thought, a thought discussed quite frequently by some of us. Among all the educated classes, the engineers are the one group in closest touch with labor. It is the part of wisdom and our duty to Society to try to understand the strivings of the working classes for our own benefit and to interpret them to the rest of the community. If the British Labor Party has been able to frame a reconstruction program and to produce a document commanding the admiration of most thinking men, surely it behooves us, the engineers, the men of whom, on account of training and experience, industrial leadership might reasonably be expected, to discuss the mighty problems now before us. And just to show how old this thought is in our Society, let me read a paragraph from Dr. Thurston's Presidential Address in 1882, the third year in the existence of our Society:

> In singular and discreditable contrast with all the gain in recent and current practice in engineering stands one feature of our work which has more importance to us and to the world, and which has a more direct and controlling influence upon the material prosperity and the happiness of the nation than any modern invention or than any discovery in science. I refer to the relations of the employers to the working classes, and to the mutual interests of labor and capital. It is from us, if from any body of men, that the world should expect a complete and satisfactory practical solution of the so-called "labor problem." More is expected of us than even of our legislators. And how little has been accomplished?

We speak so frequently of reconstruction, but as on the battlefields of France this cannot mean the restoration of all the old and often unwholesome dwellings that have been destroyed, so the reconstruction that we have in mind should not mean a reestablishment of institutions superannuated long ago but only broken down in the days of stress that we have passed. Many of the old conditions we do not want again; the *status quo ante* is not desired; and even if desired could not be revived. But what we wish is a renaissance rather of our institutions, with higher ideals and a clearer purpose than we have had before.

BUSINESS MEETING

Proposed Constitutional Amendment to Provide for Representative Nominating Committee—Addresses by Presidents of Civil and Electrical Engineers—Presentation of Report by Aims and Organization Committee

THE annual business meeting of the Society was held in the Auditorium of the Engineering Societies Building on Wednesday, December 4, at 10 a. m. After calling the meeting to order, President Charles T. Main announced that the Committee on Constitution and By-Laws was ready with a report on the proposed amendment to the Constitution and that it would be presented by Past-President Jesse M. Smith, chairman of the Committee.

Mr. Smith stated that the proposed amendment was designed to take from the hands of the President the appointment of a Nominating Committee for officers of the Society and put that authority into the voting membership. The committee, who had considered the amendment at length, had couched it in broad language so as to permit of one or more nominating committees being appointed, and had left the matter of details as to formation of committees, their number and procedure to be handled by by-laws.

On motion of Prof. A. M. Greene, Jr., seconded by L. C. Marburg, it was unanimously voted to submit the proposed amendment (published in THE JOURNAL, December 1918, p. 1066) to letter ballot.

At the request of President Main, the Secretary briefly commented on some of the outstanding features of the reports of the various Standing Committees of Administration, and stated that it was the urgent desire of these committees to obtain an expression of opinion on the part of the membership regarding the work of the Society. The Finance Committee, he said, was dealing with a budget larger than that of any other professional society in the world, save two, amounting to $236,000 for the coming year, which, it might be stated, was well within the income of the Society. The Meetings and Program Committee, it would be seen in their report, was extending the scope of the work of the Society so that it was really becoming a society of the industries. In close connection with their work was the recent action of the Publication Committee in recommending the purchase of the Engineering Index, ownership of which had now been acquired from its former publishers. It was proposed to further extend the usefulness of the Index by making avail of the unequaled facilities afforded by the Library. With the growth of the Society, whose membership had almost reached the 10,000 mark, and the realization of projected plans regarding its publications, its revenues would not only support all of the present activities but would make it possible to appropriate substantial sums for research work. The vote that had been taken on the proposed amendment he regarded as the most momentous in the history of the Society.

A. W. Robinson emphasized the importance of the Society's broadening its activities by taking up economic questions, such as the conservation of natural resources, coal consumption, the gasoline problem, ocean transportation and the like, and not leaning too much to mechanical details.

ADDRESSES BY PROF. A. N. TALBOT AND PROF. COMFORT A. ADAMS

The latter half of the meeting was devoted to a consideration of the work of the Society's new Committee on Aims and Organization. Prior to the presentation of the preliminary report of the Committee, however, President Main called upon Prof. A. N. Talbot, President of the American Society of Civil Engineers, to address the meeting on this subject. At the conclusion of his remarks, Vice-President Charles T. Plunkett was asked to occupy the chair, whereupon L. C. Marburg, chairman of the Committee on Aims and Organization, presented its report. Abstracts of the addresses of Professor Talbot and Mr. Marburg follow this report.

Chairman Plunkett then introduced Prof. Comfort A. Adams, President of the American Institute of Electrical Engineers, who spoke briefly on the public service the engineer should render to society.

At this particular time, said Professor Adams, with the whole civilized world in a state of ferment, it certainly behooved us to take account of stock, not only to investigate our work in the technical field, not only to see whether we were serving our profession as professionals, as individuals, as a rank and file, but also, and equally important, to see whether or not we were serving society by playing our part in the great movements that were going on about us.

The American Institute of Electrical Engineers, he thought, was, if not the first, one of the first of the societies to take cognizance of the interests of its outlying members by the establishment of sections throughout the country, and this establishment of sections and branches—branches being established in the educational institutions—had proved very helpful. There were, however, many problems common to all the societies which had to do with the meeting of the demands and the interests of the rank and file of the membership, and one of the most important features of this broad task of review, development and progress of an organization should be the consideration of the interests of its members at large.

But we must go even further than that as individual societies—we must take cognizance of our relations to each other as societies. We were coming more and more to realize that there was no line of demarcation between civil, mining, mechanical and electrical engineering, and no sharp dividing line between engineering and industry, industrial management, administration, politics, economics and many other things. We were so intimately associated with these outlying fields, these broader questions of industrial economics of labor and capital, that it was impossible for us if we were to take our proper place in society, to sit down and allow lawyers and editors to handle these great questions alone, and we to stand apart and aloof. We must get into politics and take a hand in the legislation of the nation.

It had often been said that the engineer's training was such as to give him a position of special advantage, because he was dealing with the hard and fast laws of nature, which did not yield to his individual interest—he was forced to think straight. That was all very true, in so far as he was strictly a technical engineer, but much of our work got outside of that.

Moreover, the engineer was many times at a disadvantage, because he was in such close touch with the financial end of things that it sometimes outweighed the other side of his training. We were not less human than members of other professions, in all probability, in being swayed by our own immediate material interests. But we had, nevertheless, this background of law and science on which we should be building, not only an engineering structure, but we should be able to apply these same principles and these

same habits of thought to the solution of many of our economic problems.

The labor question was one of the most difficult problems before the nation in this reconstruction period. We could meet it in a progressive way, trying to face it fairly and squarely, to set aside tradition and past methods and clearing away divisions of personal interest, and realizing that the real interests of labor cannot be separate or distinct from the real interests of capital or the engineer. Or we could employ the method of suppression; but that, like the suppression of the expanding power of explosive force, was apt to result in an explosion. This was no light matter—it was not a mere conjecture—explosions of this nature had occurred in other nations, and it was not an altogether foregone conclusion that they might not occur here.

SUGGESTIONS FOR THE ORGANIZATION OF ENGINEERS, BY PAST-PRESIDENT JESSE M. SMITH

Following the remarks by Dr. Talbot and Professor Adams, Past-President Jesse M. Smith said: "I have listened with very great pleasure to what the President of the American Society of Civil Engineers has said and to what the President of the American Institute of Electrical Engineers has said, and it only goes to show how very closely we are getting together as a body of engineers, without regard to specialty. In this connection I am tempted to read from a letter which I recently wrote on the question of the comprehensive organization of the Engineering Profession in America and the relations of such an organization to the present United Engineering Society.

The Charter and By-Laws of the United Engineering Society are very broad in their scope and cover many functions which have not as yet been utilized.

The U. E. S. at first only utilized one of its functions: namely that of a holding society for the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, which are the "Founder Societies," by which the title to the real property owned jointly by the "Founders" might be held by one society. This function I have always considered a minor function but a very valuable one, particularly in the early days when the first steps were taken to solidify the profession.

Other functions have from time to time been utilized but none of them to their full extent as yet. I refer to the Library Board, the Engineering Foundation and the Engineering Council. The work of each of these boards has been well started and will be perfected and extended. The proper financing of these different Boards seems to me to be the principal difficulty and should be undertaken by *one society*.

Now comes what seems to me to be the *principal function* of the U. E. S.: the *purely professional function*.

In order that the profession may be truly solidified, I believe that there should be *one* American Engineering Society and that the U. E. S. and its four Founder Societies should be merged into *that one*, not only for business purposes but also for social purposes and for the general good of the profession, but principally for *purely professional purposes*.

Let me briefly outline a plan which has been revolving in the back of my head for several years.

1. Let the members of the four Founder Societies take membership in the American Engineering Society in such grades as they are qualified to occupy according to the present qualifications for membership in the Founder Societies. These qualifications are now substantially the same in each of the four Founder Societies.

2. Let all other engineers, who are members of other societies or are not members of *any* society, take membership in the American Engineering Society according to their ability to meet the qualifications established by this society.

There would thus be created a National Society of enormous membership, of 100,000 or possibly 200,000 members.

Such a society would be unwieldy for the transaction of its affairs, either professional or business, were such affairs not committed to boards or committees. Many engineers regret the passing of the smaller societies where the members came into close personal touch and the papers were freely and intimately discussed. This was true of each of the Founder Societies in their earlier days—but those days have now passed.

To meet these objections, which are real, it is proposed to form the large membership of the American Engineering Society into branches—or groups according to *Specialties in Engineering*.

Each of the four Founder Societies contains engineers of quite different specialties. For example, the Civils contain railroad engineers and hydraulic engineers; the Miners contain metallurgical engineers in iron and mining engineers of precious metals; the Mechanicals contain steam engineers and machine-tool engineers and the Electricals contain telephone engineers and power-transmission engineers, and there are still other specialties of importance in each society. Many of the specialties have no close relation to each other in a technical sense but they all are a part of the engineering profession.

Suppose, for example, there be ten or fifteen such branches or groups, which number could be increased as the demand required.

Each branch should consider *only purely professional subjects* in its own specialty and its affairs should be in charge of a committee of its *own members* elected by the *members* of the branch, and should be presided over by a vice-president, also *elected by the members of the branch*, and who should also be a member of the governing body of the society.

The governing body or Board of Directors of the society should consist of:

The President to be elected by the entire voting membership of the society.
One Vice-President to represent, and be elected by, the voting membership of each branch.
One Director to represent, and be elected by, the voting membership of each branch.
A Technical Secretary of each branch.
A General Secretary of the society.
A Treasurer of the society.

The Board of Directors should control the general affairs of the society and direct the policy of the society as well as the general policy of the branches, leaving to each branch the detail of the conduct of its own meetings.

All publications should be undertaken by the society. The proceedings of each branch should be published as a separate volume. One volume should be given to each member of the society free of cost, but he should have the right to subscribe for as many other volumes as he would care to pay for at cost price. All volumes should be available for sale to the public at more than cost price for the benefit of the society.

Membership fees in the American Engineering Society should be as low as possible in the junior grade and increase with the higher grades so that there would be ample funds from membership fees to meet the requirements of the society in all its activities.

So much in a broad way for the professional side of the question.

Now for the social side: The getting together of engineers in elbow touch for conference and social intercourse is quite as important as the professional contact.

The social and professional contact should not, however, interfere with each other and should be organized in a sense independently of each other. Members of the society should all be eligible to membership in the social organizations but should only become members of those social organizations upon the payment of a separate fee for the support of those organizations.

The American Engineering Society should encourage the formation of a series of engineering clubs in different cities which would be the centers of engineering activities in those cities and which would naturally be the centers of professional sections of the American Engineering Society in those cities.

When the Founder Societies and other engineering societies are merged into the American Engineering Society the local sections of these various societies would also naturally be merged and have their centers in local engineering clubs.

Local engineering societies might also be merged into such local sections and clubs.

A member of an engineering club in any city should be given the privileges of the engineering clubs in other cities.

Professional engineers will only become a real power in our country's affairs when they are consolidated for coöperation in professional work and become *a single unit* in all that relates to the profession at large.

In the short time remaining for discussion the addresses of the morning were briefly discussed by Dr. John A. Brashear, J. Clinton Parker, L. W. Wallace, H. H. Suplee and Spencer Miller. Dr. Brashear cited instances from his experience with Presidents Cleveland, Roosevelt and Taft, showing the interest they had taken in scientific matters submitted to them and their willingness to be of assistance. Mr. Wallace was of the opinion that engineers should make their influence so potent in economic, industrial, political and engineering matters that the public would be forced to realize that they are a body of highly trained professional men deserving of high recognition and appreciation. Mr. Miller spoke of the recognition the engineer is now receiving in Washington. He counseled brevity in any statement of aims and thought it would be fortunate if such an expression could be brought down, say, to fourteen points. The meeting then adjourned.

ENGINEERING SOCIETIES' COMMITTEES ON AIMS AND ORGANIZATION

By ARTHUR N. TALBOT,[1] URBANA, ILL.

THE work given to the committees which have been formed by at least three of the Founder Societies has its purpose well expressed by the name given to the committee of The American Society of Mechanical Engineers—the Committee on Aims and Organization. The resolutions of the Board of Direction of the American Society of Civil Engineers creating the Committee on Development of that society instructs the Committee to report on the purpose, field of work, scope of activity and usefulness, organization, and methods of work of the society. It is apparent that the committees have much in common and that there should be full and free coöperation. What should be the aims and purposes of such societies, how they may best be organized for present-day conditions, and what they may be expected to accomplish are then within the scope of the work of these committees.

These are times of development. The great world war and all the attending phenomena have brought about new conditions. Men are thinking outside the lines which formerly limited their thoughts and methods. The existing state of flux in sociological and economic conditions may deeply affect the opportunities and responsibilities of the engineer. Great changes and great development may be expected to follow. It is apparent to many observers that a larger sphere of activity and usefulness will be opening to the profession of engineering, if only the engineer is ready to undertake his part now and later. And, besides, the engineers' work has developed so rapidly and so diversely in the past forty years that we hardly know where we are. Engineering societies have grown at a very rapid rate; local and specialized engineering societies have sprung up everywhere. The conditions in the more remote parts of the country may differ materially from those in and around New York. In all there are some 35,000 members of the four national engineering societies. How many there are in the hundreds of local and specialized engineering societies, is not known. It is considered by some that the number of men who may justly claim the right to be classed as engineers runs up to more than 100,000.

In view of all this is it not well to seek to make a survey of the aims and purposes of the engineering societies, to ask whether they are occupying all the fields of usefulness open to such societies and whether they are accomplishing all that may reasonably be expected of such organizations?

Even if the survey made by the committees should result only in broadening and intensifying and emphasizing the activities, functions and methods of work already in existence, the effort will be worth while. More likely, the study of the problems will show new opportunities and responsibilities devolving upon the societies, and especially that, whether inside or outside the field of the national engineering societies, there are matters of public and semi-public nature which should be considered by the engineering profession more fully than has been the case in the past.

In taking up this inquiry no one should feel that the consideration of aims and organization is in any way a reflection on the conduct of our societies in the past. All will agree that their record is most excellent. The accomplishments of the societies, technical and extra-technical, redound to the credit of the societies and their membership. These societies have helped to create the engineering profession. In ways that are not usually recognized the engineering society has been a benefit to the engineering profession and to the public. It has given esprit de corps to the profession. It has made its members feel self-respecting—more, it has shown many the high standing of the profession and the responsibility attached to membership in it. It has raised the standards and the standing of the engineering profession, and has assisted in establishing this standing in the eyes of the public. In such ways as this it has more than justified its existence. But may not the engineering society do even more than it has in giving standing to the engineering profession?

The engineering society has been very helpful in technical matters. In fact, in the eyes of many, the presentation and discussion of papers on technical engineering subjects should be almost the sole function of the engineering society. This is a worthy function. Engineering is and must continue to be a technical art, a technical business. Is it not likely, with the great development of the science and art of engineering, that the engineering society has not yet realized the possibilities of its usefulness in developing, recording and disseminating the technical side of engineering, the scientific substructure, the overlying elements of practice, the variform connections with business life? Especially may it not be more fruitful in contributing to engineering knowledge and in creating or developing new engineering policies, and in developing engineering practice and engineering improvments?

If one were to recount the accomplishments of the engineer in civic affairs, in governmental activity, in influence upon public policy, in the solution of industrial problems, the record would be surprising and greatly to the credit of the engineer. The accomplishments of the engineering societies along these lines are likewise very creditable. But as new conditions teach new duties, it is worth while inquiring whether the engineer and the engineering society have not now opportunities and responsibilities in the direction of public duty far beyond that which has usually been considered a sufficiency. If a need is found, means must be found for expansion, if such expansion is practicable. The problem is a complicated one. The engagements of most engineers are not like those of the lawyer. There is a great diversity of condition of service and environment, even in the same lines of engineering. It is also evident that matters affecting general public policy, to have the best effect and the greatest influence, should be discussed by all branches of engineering in every part of the country; and matters of regional, state or local interest may be handled only by those in the localities interested.

It is becoming more and more apparent that engineering is a single profession; the various branches merge and ramify into each other in numerous ways. Many engineers think that there should be one large inclusive engineering society to take the place of the several national societies—but evidently that is not a present probability. Much has been done in recent years in the way of coöperation and united effort; the United Engineering Society and the Engineering Council have unified action in commendable ways, there is a great field for their further endeavor. In any discussion of the subject it must be borne in mind that the membership of the national societies is scattered over the country; that there are numerous centers of engineering and that these are yearly becoming more important; that local engineering societies in these centers are essential elements in the life of the engineering profession; that these local societies furnish the means by which the young and growing man meets and knows other engineers and gains opportunity for development; and that the national societies may be greatly strengthened and their influence extended by closer affiliations with these local societies; and that any thorough consideration of the subject of aims and organization should endeavor to find ways and means by which the sections of the national societies may best effect close coöperation with the local societies and extend the opportunities of members and the influence of the engineering profession. The problems of the coördination and unification of the engineering profession are numerous and complicated, but nevertheless no one will doubt that every effort should be made to strengthen organization and to attempt to make the engineer a greater force in the world.

It is apparent that the subject assigned to the committees will require diligent and earnest study and consideration, and that their reports will need careful deliberation by the societies. What are the best lines for expansion and improvement and what may be accomplished for the good of the profession and the public are matters which may well tax the powers of the committees and the membership; what is practicable and what is visionary; what may be done by the engineering society and what may best be relegated to individuals or to auxiliary or separate organizations or given up entirely, must all be threshed out in detail.

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[1] President American Society of Civil Engineers; Professor of Municipal and Sanitary Engineering, University of Illinois. Mem.Am.Soc.M.E.

Abstract of address delivered December 4, 1918, at the annual meeting of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE ACHIEVEMENTS OF NAVAL ENGINEERING IN THE WAR

By LIEUT.-COM. WILLIAM L. CATHCART,[1] U. S. N. R. F.

DURING these more than four years of war we have heard much in criticism of the Silent Fleets—of the mute guns of that vast Allied Armada waiting tensely, like a crouching lion, for the German High Seas Fleet, which—save for its half-hearted dash at Jutland—never came.

And yet, notwithstanding these criticisms, the ex-Kaiser, his craven commanders on land and sea, and now all Germany know that to those Silent Fleets is due primarily the shattering of their dream of world dominion—a dream whose realization meant to us and to our Allies but world despair.

This assertion of the paramount value of sea power involves no detraction from the honor fitly due those magnificent Allied armies, the white crosses of whose dead crowd all Europe. And it minimizes in no way the achievement of the superb troops of the American Expeditionary Force, who—in but half a year's hard fighting against the flower of Germany's armies—have won undying glory for our flag.

But, predominating sea power was the foundation on which all of these victories on the land were based. From the beginning, the British Fleet attained the ultimate object of all sea warfare, in making impotent the enemy's naval strength in surface warships—the only kind that count in the end—and that impotence has had a vital effect on the conduct and success of the war.

The reason is clear. Every one knows now that an army on the land or a fleet on the sea becomes helpless if its lines of communication with its base are cut. In this conflict, the Western Front was the decisive theater of war. And for the Allied armies on that front the ultimate bases of supply and reinforcement lay beyond the sea—in Great Britain, her colonies and dominions; in India and Algiers; and—most important of all—in distant America.

So, the absolutely vital lines of communication of those armies stretched like a vast network across the Seven Seas. And, if Germany's High Seas Fleet had been free to wreak its ruthless will, those lines would have been quickly cut, England would have been isolated, America powerless to aid, and—long before we could have entered it—the war would have ended in bitter tragedy for all mankind that is worth while.

While the defeat of the Central Powers is thus due primarily to the early strength and continuous growth of the British Fleet, our own Navy has had no inconsiderable part in the decisive work of the war's last year. It has convoyed across 3000 miles of sea more than a third of that American Army of two million men which gave preponderating military strength in France—an achievement which, for rapidity of execution and the distance covered, is without parallel in the history of navies. During the last three months of the war, for every minute of the day and night, seven American soldiers, their equipment, and the maintenance for them, arrived in France.

Our Navy in This War

From the very day of America's entry into the war our Navy grew by leaps and bounds until it became 600,000 men strong and operated about 2000 armed vessels and transports. On September 1 we had in European waters a total of about 275 ships carrying about 57,000 officers and men under command of Vice-Admiral Sims. These vessels comprised: First, a large division of dreadnaughts in the North Sea; second, cruisers serving with the British in the White Sea and the North Sea, with the British and French in the Atlantic, and with the French, Italian, and Japanese in the Mediterranean; third, about a hundred destroyers operating from several European bases; fourth, a swarm of submarine chasers dashing through British, French and Italian coastal waters; fifth, a flotilla of submarines engaged in hunting enemy boats of their own kind; sixth, a number of small patrol vessels—coast guard ships, yachts, seagoing tugs, and the like; and, finally, some naval auxiliaries, such as mine layers and repair ships.

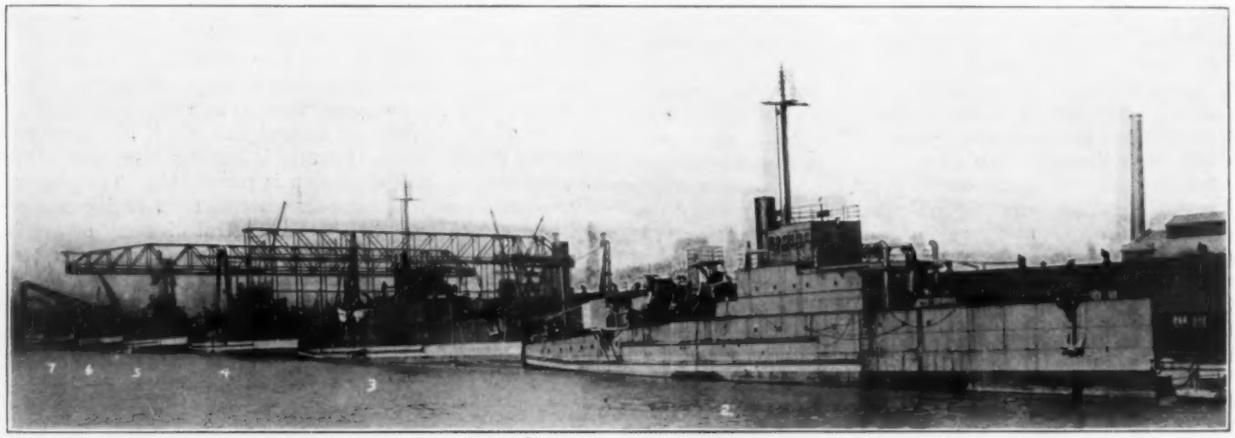

Fig. 1 The "Eagles"—Ford Boats

But, the story of the Navy in this war is very far from ending with the record of its ships in European waters. For, we have maintained also a huge Atlantic Fleet whose vessels have not only guarded our coasts and the near-by ocean lanes, but have formed a great training school from which have come the picked men for European service, the gunners for many hundreds of merchant vessels carrying armed guards, and the crews for Army transports and for the Naval Overseas Transportation Service—that is, the vessels built by the Emergency Fleet Corporation.

When we remember that the maritime area of this country forms so small a part of the whole, the wonder is that, in so brief a period, 600,000 men—coming largely from interior states—could be trained for efficient service afloat in our home and foreign fleets. Sir Eric Geddes justly terms the achievement of the Bureau of Navigation in this work as "an amazing feat."

But, what is thus true of one Bureau in this war, is equally true of all in the Navy Department—the great shore establishment which stands behind the Navy afloat and without whose full efficiency, effective service by our Fleet would be impossible.

So, what follows of the record made by the Bureau of Steam Engineering should be regarded as but a sample of what all these Bureaus have done. From the beginning of the war, the entire Navy Department has been working, in a clean-cut American way, at maximum efficiency under forced draft.

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[1] Bureau of Steam Engineering, Navy Department. Mem.Am.Soc.M.E.

Address (abridged) delivered at the Annual Meeting of The American Society of Mechanical Engineers, December 4, 1918.

I shall limit my lecture to the work of the Bureau of Steam Engineering, and shall be able to handle even that work only in a very general way, since the Bureau's field—which is dynamical engineering largely—covers all steam and internal-combustion engines for the Navy; the bulk of its electrical machinery and apparatus for surface ships, submarines, and aircraft; the machinery and apparatus of aircraft; the generation and supply of gas for observation balloons and dirigibles; and finally the design and supply of the entire wireless equipment of all shore stations for radio telegraphy in the United States, in our island possessions and on every vessel, merchant or naval, flying the American flag.

The Stupendous Task of the Bureau of Steam Engineering During the War

When the war began, we had a Navy of about 350 ships—commissioned, in reserve, or building. But, the fleet grew with amazing rapidity, and, at the close of the fiscal year on June 30 last, the Navy had in service, or soon to be commissioned, a total of 1959 vessels. This total comprised 570 ships of the regular Navy; 93 drawn from other Government services; 937 converted merchant ships, used as troop transports, naval auxiliaries, and in patrol; and, finally, 359 vessels built by the Emergency Fleet Corporation for the Naval Overseas Transportation Service.

The aggregate horsepower of these vessels is about 6,500,000—which is thirteen times that of our fleet during the Spanish-American War. And, further, it is more than ten times the power developed on both sides of Niagara Falls, and is also equal to about one-sixth of the primary fuel and water power now employed in land service in the United States, not including the locomotives.

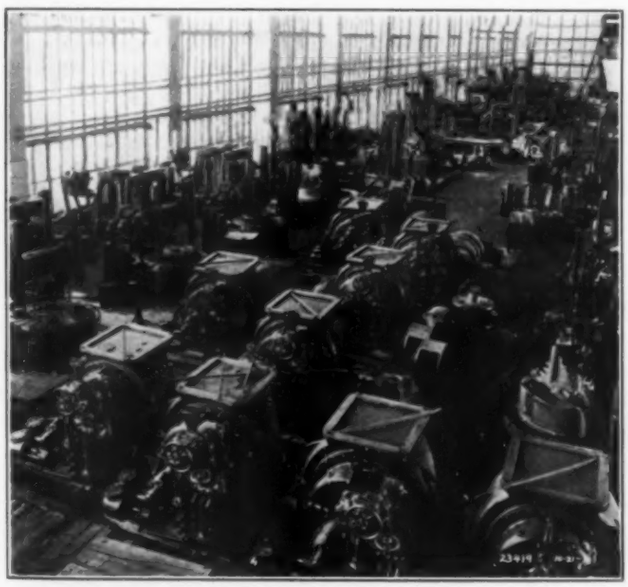

Fig. 2 Machinery for the "Eagles"

But the maintenance of machinery of this huge power was not all, for at the close of the fiscal year there were under construction 376 combatant and auxiliary vessels and 52 tugs for the Navy. Included in this number is a huge force of destroyers. When these vessels are completed, the present horsepower of the Navy will be increased by 70 per cent, and become 11,000,000.

Organization of the Bureau of Steam Engineering

For clearness in discussing the work of the Bureau of Steam Engineering, let me give a brief outline of its organization and principal activities.

The Engineer-in-Chief determines all questions of Bureau policy, authorizes all expenditures, and decides all important—and many minor—questions of detail.

The Assistant to the Bureau, Captain Oscar W. Koester, handles routine business in technical and administrative matters; investigates all work and expenditures in connection with the organization, building, equipment, and maintenance of the shops of the Machinery Division at Navy Yards and Repair Bases; and, when necessary, inspects and reports on the condition of the Bureau's work at private plants.

The staff of the Bureau is separated into ten divisions—one clerical, headed by the Chief Clerk; and the remainder, technical. The duties and titles of the nine latter divisions are: Design,

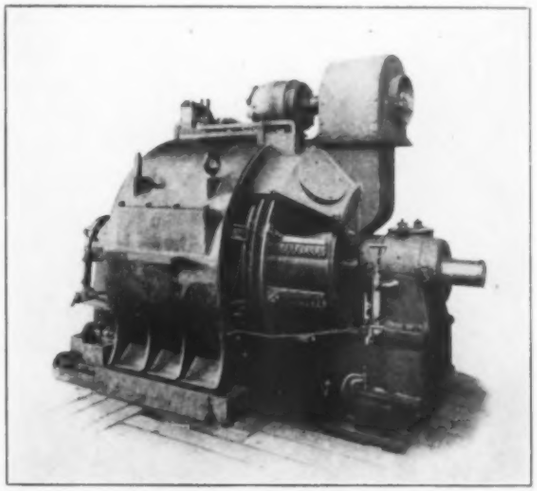

Fig. 3 Motor for Submarines

Electrical, Repairs, Radio Telegraphy, Inspection, Supply, Fuel and Personnel, Aeronautics, and Logs and Records.

Each of these divisions is in charge of an officer who is an expert of high rank in his especial field. The muster roll of the Bureau's divisional heads is in this respect a roll of honor. While the work of the Bureau is thus divided, Admiral Griffin keeps in close touch with it all. His guiding hand is felt, in greater or less degree, in every detail.

Division of Design. The Division of Design is in charge of Rear-Admiral Charles W. Dyson, an officer who has long been widely known for his success in the design of naval machinery, and especially of propellers—that marine mystery of many weary years.

The duties of this Division cover a broad field. As to new vessels, for example, it recommends the type of machinery to be adopted; estimates the power required for propulsion; makes the general design of the machinery selected by the Engineer-in-Chief; draws the contract-plans and specifications; investigates the bids and alternative plans submitted by contractors, and makes recommendations; criticises the detailed plans forwarded by contractors; prepares directions for the trial of the machinery; and finally makes recommendations as to payments on the contracts.

During the last two years of the war, this comprehensive work was done for vessels of all classes—built, building, or contracted for—aggregating 9,501,440 hp., as follows:

Destroyers	6,578,000	EFC oil tankers	31,800
Battle cruisers	1,080,000	Harbor tugs	12,000
Battleships	480,000	Fuel ships	10,400
Scout cruisers	630,000	Motor tugs	2,800
200-ft. patrol boats	280,000	Ammunition ship	10,600
Mine sweepers	75,600	Oil and water barges	2,400
Sea-going tugs	48,600	Gunboat	1,600
Submarines	41,640	110-ft. patrol boats	216,000

In addition to the work on new vessels, the division passes on all alterations to the existing machinery of naval vessels and those of the Naval Overseas Transportation Service. It also specifies the materials and their characteristics for marine engineering construction, and has general supervision of all tests and experiments relating to marine propulsion at the Engineering Experiment Station at Annapolis and the Fuel Oil Testing Plant at the Philadelphia Navy Yard. Similarly, it has general supervision

of the Inspection Force at building yards—a work in which the Bureau has at this time about 60 officers engaged.

Electrical Division. When we entered the war, the Electrical Division was in charge of Commander Guy W. S. Castle, who has been succeeded very recently by Captain C. E. Courtney.

This Division supplies all the electric power, the wiring for all purposes, and roughly about 75 per cent of all electrical machinery and apparatus on naval vessels. Its field is therefore a

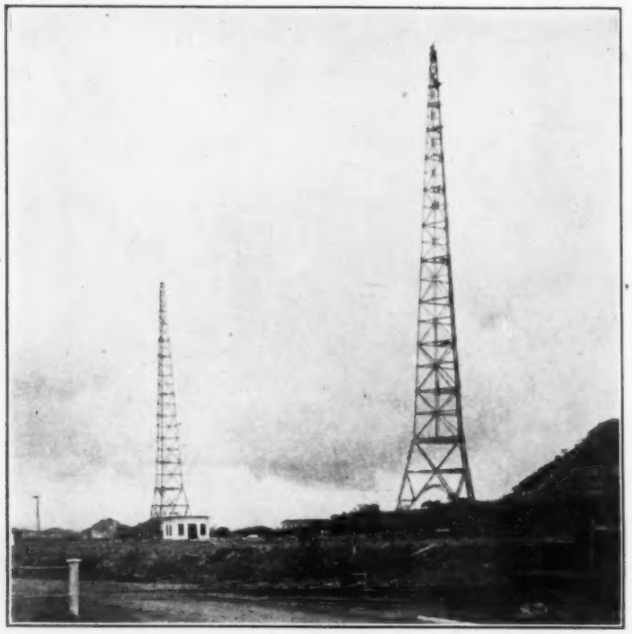

FIG. 4 U. S. NAVAL RADIO STATION, BALBOA, CANAL ZONE

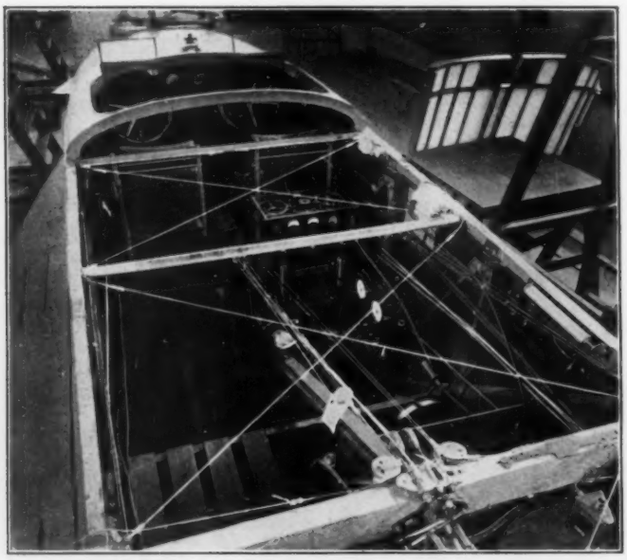

FIG. 5 WIRELESS TELEPHONE SET: TOP VIEW

most important one, extending to communication systems for the control of gun fire, the electrical signals for day and night use which are so necessary for the handling of ships in company at sea and in making recognition signals, searchlights for protection against destroyer attack at night, the motors and storage batteries for the propulsion of submarines when submerged, anti-submarine and anti-aircraft devices, all interior communication systems, the multitude of other appliances in which electricity serves on shipboard, and the electrical equipment of the Machinery Division at navy yards. In this work, the Bureau has expended about $20,000,000 during the last fiscal year.

In original work, Commander Castle supervised the development of certain anti-submarine and anti-aircraft devices which are of a confidential nature. These submarine detectors have been made in quantity, not only for our own vessels, but for the British Admiralty and the French Ministry of Marine. For the anti-aircraft investigation, Dr. G. W. Stewart of the University of Iowa made for the Bureau a comprehensive study at Pensacola, Florida, of all the noises made by the engine and wings of an airplane in flight. From his results and in coöperation with the Signal Corps of the Army, a scheme of sound ranging on enemy airplanes was devised, and the necessary instruments were designed and made.

Unquestionably, the most important electrical accomplishments of the Bureau during the war have been the remodeling and improvement of the wiring for gun-fire control systems in all ships from dreadnaughts to gunboats, the installation of communication systems for the service of the guns on transports and ships carrying armed guards, and the provision of recognition signals on all vessels acquired or operated by the Navy.

Supply Division. The Supply Division is in charge of Lieutenant-Commander Charles K. Mallory, U. S. Navy (retired), a member of this Society, who—on the mobilization of the Navy for war service—was assigned to this duty as the relief of an officer on the active list.

Matters relating to engineering materials and supplies—under cognizance of the Bureau of Steam Engineering—for vessels of the Navy and for Navy Yards, are handled through this Division. The specifications for the material are drawn by the technical Division concerned, and all subsequent questions of a technical nature are referred to that Division for decision. Hence, the Supply Division is, in some respects, a sort of center of business activity for the Bureau in its contact with bidders and contractors.

Upon our entry into the war, it soon became apparent that the question of obtaining material and supplies—both for the direct use of the Navy and for those having contracts for new construction—would be of increasing importance and difficulty. Owing to the unsettled conditions as to materials, supply, and labor, it became necessary to abandon the penalty for failure to complete contracts on time, and in many cases contracts had to be changed

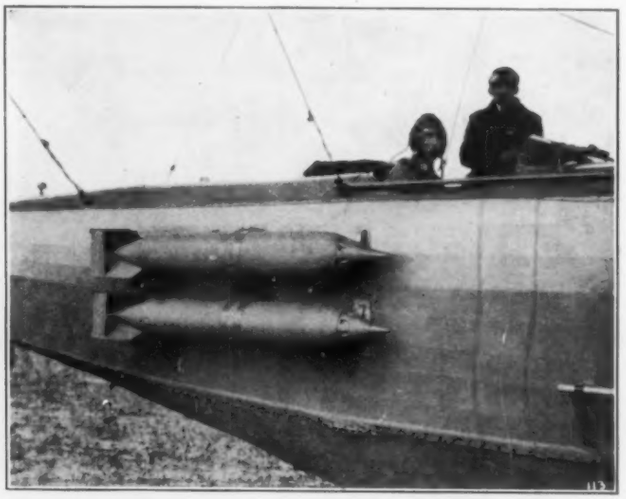

FIG. 6 U. S. NAVY TWIN-ENGINE DIRIGIBLE, SHOWING BOMBS IN PLACE, RADIO TELEPHONE IN USE AND ANTENNA WIRE REELED UP

from a fixed-price basis to one which would insure the receipt by the contractors of a reasonable profit.

Under peace conditions it was unnecessary to give much attention to the matter of the ability of the contractor to deliver as required. This latter consideration, however, became more and more important in war time, and, to take care of the situation, a number of business men of ability—who were willing to devote their time to Government needs—were enrolled as officers in the Naval Reserve Force and assigned to production work in the various Inspection Districts. The work of these production of-

ficers was of inestimable value in obtaining material as required.

The Supply Division has also made a revision of the engineering allowance lists for all regular navy vessels, to insure their being on a proper war footing in this respect. It will be seen that, owing to the variety and volume of its work, this Division has had its hands full since our entry into the war, but its work has been thoroughly done throughout.

Radio Division. Commander S. C. Hooper, U. S. Navy, is in charge of the Division of Radio Telegraphy. The activities of the Bureau of Steam Engineering in this respect cover almost a worldwide field. All matters relating to radio equipment—except the actual operation by the radio personnel—on vessels operated by the Navy, on all vessels of the Army and other branches of the Government including the United States Shipping Board, and on merchant ships requisitioned by that Board, are directed by the Bureau. The number of these istallations now exceeds 4,000.

The Bureau's direction extends similarly to 50 naval radio coastal stations and 75 commercial coastal stations in this country; to others in the West Indies and the Canal Zone, in our island possessions and Alaska and Vladivostok in the Pacific; and finally to one now building for us at Bordeaux in France, which will be the most powerful wireless station in the world.

During the last fiscal year, four of the high-power radio stations on the Atlantic Coast—Sayville, Tuckerton, New Brunswick, and Marion—have been developed into efficient transmitting stations capable of continuous radio communication with Europe. And, further, the Annapolis transmitting station—the most powerful in the United States—was built and commissioned. This station and the four just noted would provide uninterrupted communication with our forces in France, if all submarine cables were cut.

The Bureau has also conducted a large amount of investigation and development of radio transmitting and receiving apparatus for aircraft. It has equipped 90 airplanes in the United States with satisfactory apparatus, has shipped 60 outfits to France and Great Britain, and has contracted for about 3000 more.

Radio telegraphic communication from aircraft in flight to stations on land is now possible at a distance of 200 miles. Similar communication from land stations to flying aircraft is practical up to distances of 50 miles, and communication from aircraft

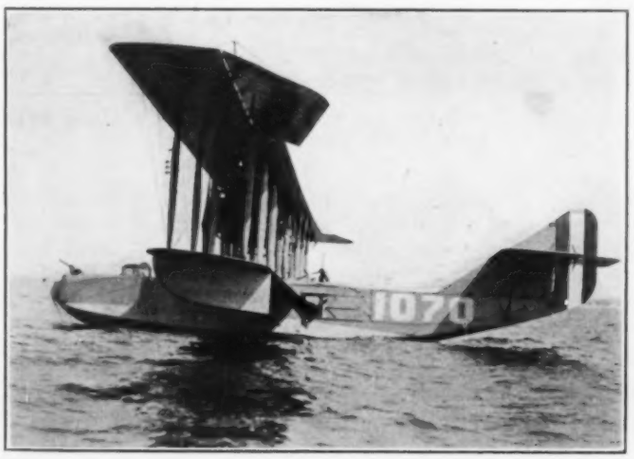

FIG. 7 U. S. FLYING BOAT H-16 FOR PATROL SERVICE; TWO LIBERTY ENGINES; CREW OF FOUR TO FIVE MEN

resting on the water to points on shore can be effected at a maximum distance of 40 miles.

The development of the radio telephone for use on aircraft has progressed to such a stage that it is now possible to communicate by this means from aircraft in flight to stations on land at a maximum distance of 60 miles. The converse of this—telephone communication from land stations to flying aircraft—is practicable at a distance of 15 miles.

Inspection Division. The Inspection Division is in charge of Commander M. A. Anderson, U. S. Navy (Retired). During the last fiscal year this Division inspected, for its own Bureau and six other Bureaus of the Navy Department, nearly 8,000,000 lb. of engineering and other material. This inspection was conducted by a force of 306 naval officers and civilian assistants who visited more than 2,000 manufacturing establishments in this work.

Fuel and Personnel. The Fuel and Personnel Division is in charge of Commander H. A. Stuart, U. S. Navy. During the greater part of the year, it was headed by Commander N. H. Wright, U. S. Navy. Fuel oil, gasoline, and lubricating oils are

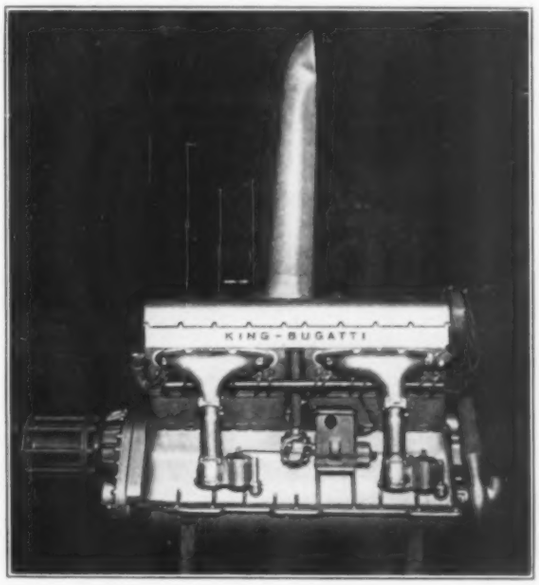

FIG. 8 KING-BUGATTI AEROPLANE ENGINE, 16 CYLINDERS

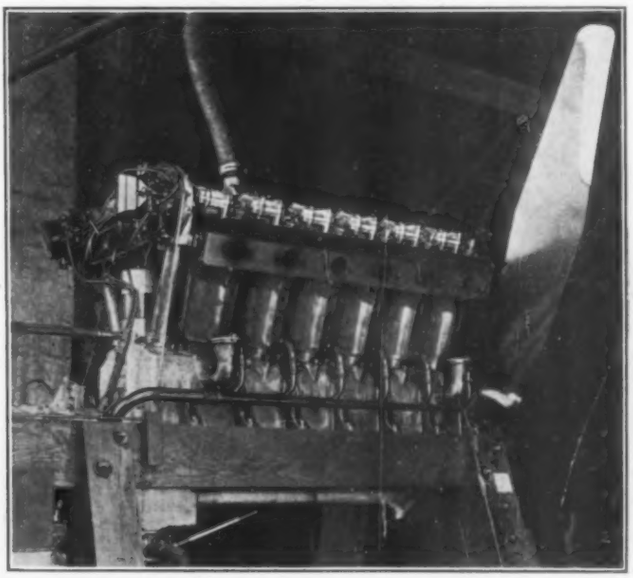

FIG. 9 LIBERTY MOTOR, 12-CYLINDER, 400-HP., STANDARD U. S. AERONAUTICAL ENGINE

vital essentials of modern navies, hence, the work of this Division is of fundamental importance, especially as the Navy is now hard pressed in its effort to retain the naval oil reserves in California. However, all of the Navy's new ships are oil burners, since, during their lifetime, fuel oil for them will not fail.

This Division covers a broad field. During the last fiscal year it assisted in extending the coaling facilities in our ports and in making a comprehensive survey of the low-volatile steaming coals with the view of locating mines capable of furnishing suitable fuel for the Overseas Transportation Service. It modified the

naval specifications to permit the use, for a time, of a considerable percentage of Mexican distillate, and made preliminary investigations for establishing specifications for heavy fuel oil for transports and cargo carriers. Further, it coöperated with various Government agencies in the adoption of standard specifications for aviation gasoline.

Division of Repairs. The Division of Repairs is in charge of Commander W. A. Smead, U. S. Navy, who has been for some months in Europe. In his absence, it is headed by Lieutenant Commander Bruce.

During the war this Division has had its hands full with the repair work for the Fleet and the vessels operated by the Navy—a total of nearly 2000 by the end of last June. However, it

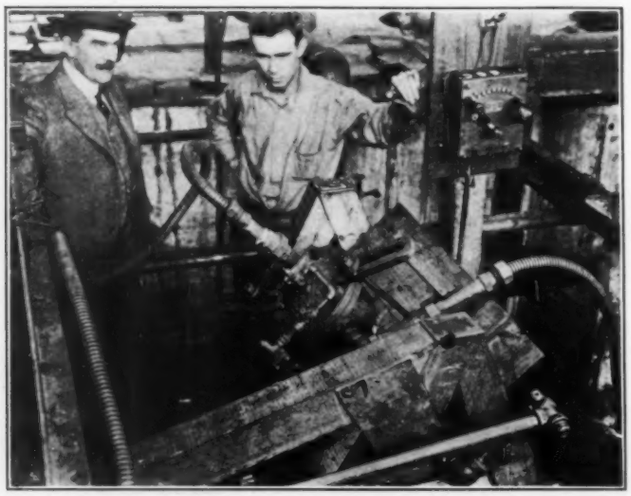

FIG. 10 STEAM TRAP MOUNTED ON ROCKING PLATFORM TO DETERMINE ITS BEHAVIOR ON A VESSEL IN A SEAWAY

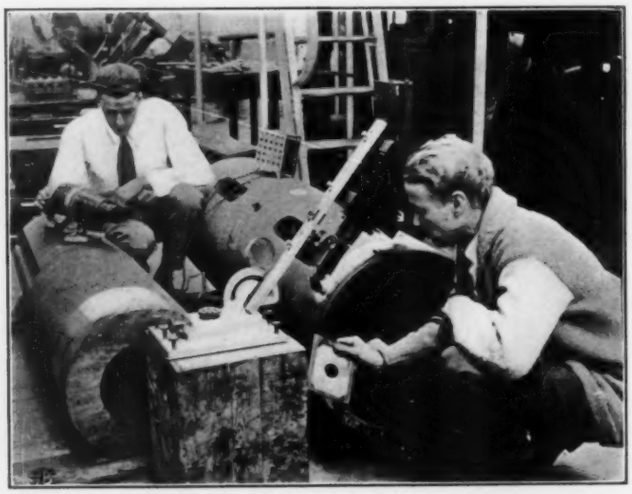

FIG. 11 MICROSCOPIC EXAMINATION OF LARGE METAL OBJECT. MICROSCOPE AND CAMERA ATTACHMENT ARRANGED FOR MAKING PHOTOMICROGRAPH OF A BROKEN SHAFT COUPLING

measured up fully to its work, and no vessel of importance has been laid up for repairs.

Since we had more than 250 vessels in European waters, the problem of their repair and maintenance was not simple. Spare parts had to be ready, and material wants anticipated. To this end, a stock of the most important engineering material was provided by this Division—some in this country, but the greater portion at the foreign bases—and its location and use so thoroughly systematized that it could be shipped upon cable advice.

For this work of repairs and supply, the Navy established a total of five major bases—three in France, one in Great Britain, and one at Gibraltar. There are also two minor bases, in or near the Mediterranean. The facilities of these bases were reinforced by those of six Repair Ships.

As illustrating the resources of the Repair ships—the retubing of boilers of a destroyer was undertaken without interruption of her regular patrol and convoy duty by working on one side of the boiler during her 5-day overhaul period, and completing the other side during the following period, and so on until all were finished—the vessel meanwhile being capable of 25-28 knots speed.

Division of Aeronautics. The Division of Aeronautics is in the charge of Commander A. K. Atkins, U. S. Navy. The work of this Division covers aircraft machinery generally, engineering design for this purpose, and the generation and supply of gas for observation balloons and dirigibles.

The marked military advantage to be gained by having but one type of airplane motor prompted the Navy Department to adopt the motor used by the Army. All Liberty motors for the Navy are, therefore, obtained through the Aircraft Production Board. Orders have been placed for more than 4000 of these Liberty engines, delivery to be completed by January 1, 1919. Of this number, about 1300 were received by the end of the fiscal year, and distributed to various naval air stations in this country and abroad. There have also been purchased about 500 Hispano-Suiza engines for use at naval air stations in this country.

In general engineering design the Bureau has done much work, especially with regard to the application of the Liberty motor to

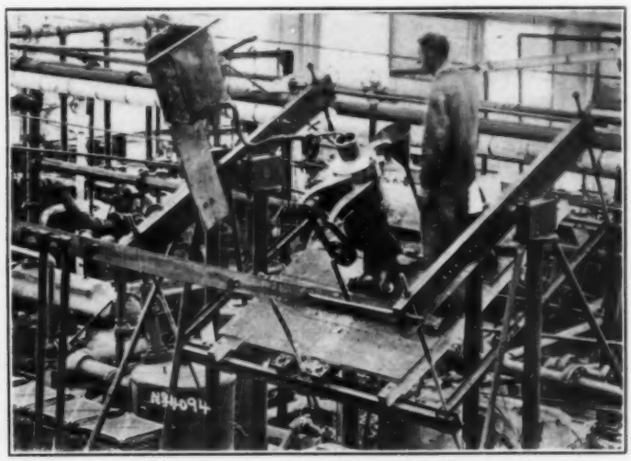

FIG. 12 CENTRIFUGAL OIL PURIFIER MOUNTED ON ROCKING PLATFORM DURING DEVELOPMENT TRIALS

seaplanes. This work covered starters and priming devices; the development of a flow meter, pneumatic spark arc throttle controls, and an oil-cooling system.

Division of Logs and Records. The Division of Logs and Records is in charge of Commander W. W. White, U. S. Navy (Retired). In the effect of its work on marine engineering design and progress, the field of this Division is of great importance.

Its main functions are: the checking-up and review of the engine-room logs of naval vessels; the compilation and issuance to the seagoing personnel and naval training schools of Bureau pamphlets relating to the care and management of machinery on shipboard; the preparation and issuance to the naval service of the Confidential Bulletin of Engineering Information; and the filing and indexing of all important data regarding engineering matters, with especial reference to naval vessels.

THE ELECTRIC DRIVE FOR BATTLESHIPS

In those stormy days toward the end of the Civil War, Isherwood, that master engineer, designed for the United States Navy the 17-knot cruisers *Wampanoag* and her sister, which—as their trials proved—were incomparably the fastest ships, naval or merchant, at that time in the world. The jealousy and ignorance of those days of semi-sail power brought down on him a storm of

criticism, and ultimately the great Engineer-in-Chief was forced to see his peerless ships rot at their moorings.

In the years since then there has been no fit comparison with this shameful episode in our naval history, except, in less degree, the similar storm which burst on the head of the present Engineer-in-Chief, when, with high courage and far vision, he urged the introduction of the electric drive for the propelling machinery of battleships and battle cruisers.

The crux of the opposition lay apparently in commercial reasons. It is true that some eminent engineers in civil life, who had no financial interests in the matter, were wholly sincere in voicing their disapproval of what—with their inadequate knowledge of naval conditions—seemed to them a hazardous venture. But, as to others: what the basic reason for the war waged on the Bureau of Steam Engineering in opposition to the electric drive was, may well be left to those who made the attack.

Throughout the controversy the Engineer-in-Chief held unwaveringly to his decision. No arguments had power to turn him, for he had—what his critics lacked—detailed knowledge, both of naval requirements and of the performance of electricity as a driving power in naval vessels. About seven years before, the naval collier *Jupiter* had been thus equipped by his predecessor in office, Rear-Admiral Cone. As soon as she was completed, Admiral Griffin sent the Assistant to the Bureau—Commander,

FIG. 13 1ST I. P. CYLINDER OF S. S. "SANTOS," NAVY YARD, PHILADELPHIA, MAY 3, 1918

now Rear-Admiral S. S. Robison—to the Mare Island Navy Yard, with orders to try the *Jupiter's* machinery at sea in every conceivable way. The report of this officer was exhaustive, and, therefore, Admiral Griffin knew, in every detail, just how the electric drive would act in all conditions. So, from an engineering viewpoint, the contest was an unequal one.

The contract trials recently of the *New Mexico*—the first of our battleships to be fitted with the electric drive—have confirmed fully the judgment of the Engineer-in-Chief. She was tested in many more ways than her contract called for, and, in all, she has shown herself, not only wholly efficient, but—in her system of propulsion, her maneuvering power, and her underwater protection—the leading battleship of her day in the navies of the world.

I need hardly say here that the steam turbine has replaced the reciprocating engine for battleship propulsion. And, I need scarcely add that the combination of a turbine—whose maximum economy is shown at 2000 revolutions or more—and a propeller—which, in a battleship, should not exceed 180 to 200 revolutions—presents a rotational problem of some complexity.

In the electric drive the turbine operates an electric generator instead of a screw propeller, and the electric power thus developed is transmitted to motors on the propeller shafts, in much the same way as electric power is transmitted on shore. In other words, there is a central power plant—composed of boilers, turbines, and electric generators—and the power is taken from this plant to the motors on the screw shafts.

This installation possesses an advantage over the direct or geared turbine drive, in that a backing turbine is not required. The reversing is done through the motors with the same ease and certainty as in any other electric-motor installation, and with the further advantage that full power can be utilized in backing.

The elimination of the backing turbine is a matter of prime importance, since most of the accidents to turbine-driven vessels of the Navy are due to it. For example, the dreadnaught *Arizona*,

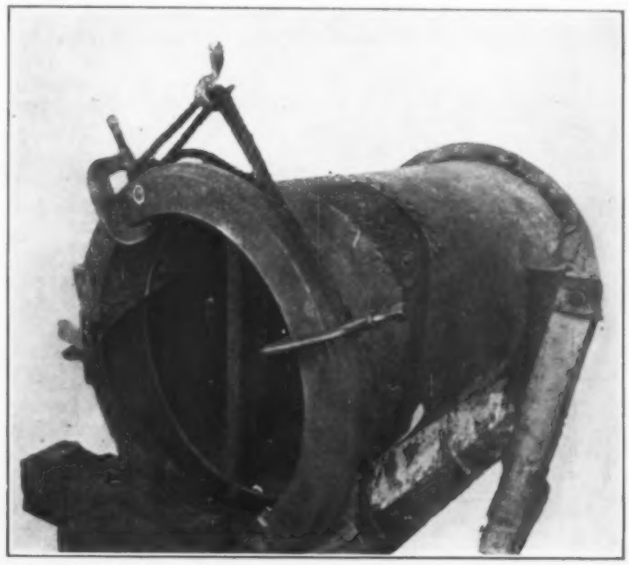

FIG. 14 1ST I. P. CYLINDER OF S. S. "SANTOS," NAVY YARD, PHILADELPHIA; READY TO WELD, MAY 29, 1918

FIG. 15 1ST I. P. CYLINDER OF S. S. "SANTOS," NAVY YARD, PHILADELPHIA; FINISHED AUGUST 15, 1918

in her first trip from New York, had been making a very fine record in straight-away steaming, but, when she began maneuvering, one of her turbines came to grief, and she had to limp back to the New York Navy Yard, with a big job of reblading to be done.

NAVY YARDS AND SHORE STATIONS

As to the immense amount of work carried on at the New York Navy Yard under the direction of Rear-Admiral George E. Burd, U. S. Navy, Industrial Manager, since April 6, 1917, Admiral

Burd and the officers serving with him have had charge of the conversion and repairs, in all departments—including the mounting of batteries in many cases—of a total of 723 vessels of all classes. Much of this work was under cognizance of the Bureau of Steam Engineering.

In addition to this, the propelling machinery—in whole or in part—of these battleships has been building there, and considerable other new construction work of a minor character. Further, there has been a great deal of electrical and radio work for vessels of all classes. The number of men employed—including the clerical, drafting, and sub-inspector force—was about 4,900.

Naval Experiment Station at Annapolis

The Naval Experiment Station at Annapolis does much of the marine-engineering research and experimental work of the Bureau.

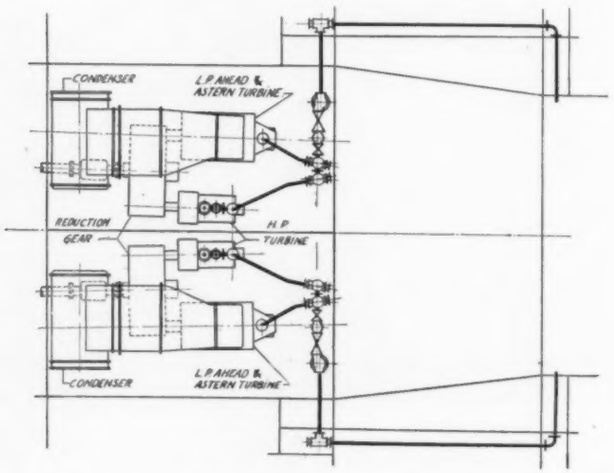

Fig. 16 Battleships, Diagrammatic Plan of Turbine Drive with Reduction Gear Showing the Arrangement of Machinery

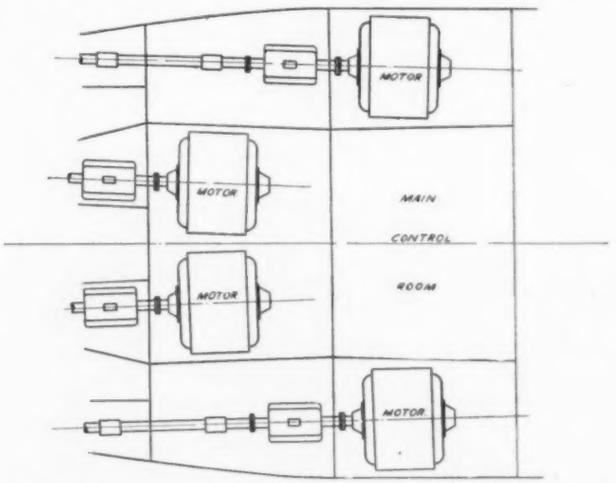

Fig. 17 Battleships, Diagrammatic Plan of Electric Drive Showing the Arrangement of Motors

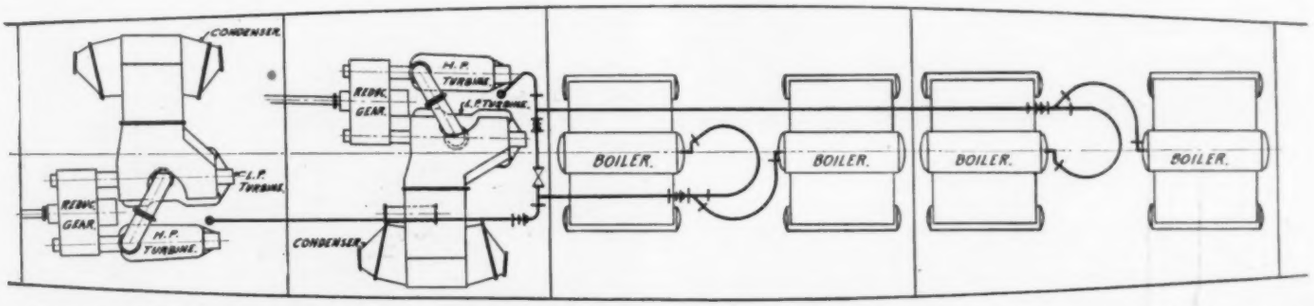

Fig. 18 Destroyers, Diagrammatic Plan of Turbine Drive with Reduction Gear Showing the Arrangement of Machinery

The Head of this Station is Rear-Admiral T. W. Kinkaid, U. S. Navy.

The services of this Station are of the greatest value, not only in the designing work of the Bureau, but in the maintenance of the machinery of the Fleet. Its chief function is the prosecution of research on, and making tests of, appliances, materials, and methods which relate to the propelling plants of naval vessels—such as forced-draft blowers, pumping machinery, feedwater heaters and coolers, refrigerating machinery, steam turbines, condensers, evaporators, boilers, coal and oil fuels, packings, and so on. The Station's activities also include much work in the metallography of steel and other metals.

Fuel-Oil Testing Plant

The Fuel Oil Testing Plant at the Philadelphia Navy Yard has also done a very considerable amount of valuable work. Its present head is Lieutenant A. M. Penn, U. S. Navy. Its field covers burners, air registers, the refractory linings for furnaces, furnace insulation, and other similar matters.

During the last fiscal year, in order to obtain comparative data of boilers of various types, a test of the White-Forster boiler was conducted at this plant. The results show that express type boilers of this kind, having a large amount of heating surface and a thick tube bank, are even more efficient at from low to moderately high rates of combustion than the straight-tube boilers now used so extensively in our Navy, but that they are slightly less efficient at very high rates. The express type has advantages also in the saving of weight, original cost, and cost of upkeep.

Repair of the German Merchant Ships Damaged by the Vandalism of Their Crews

The almost incredibly rapid repair of the German merchant vessels lying in our ports and seized by our Government when we entered the war, makes one of the most striking and dramatic stories in the history of naval engineering.

There were, in all, 103 of these German ships seized by our Government. Of this number about 50 were turned over to the Navy by the Shipping Board for Repairs. The major damage inflicted was the breaking of cast-iron parts of the main engines, chiefly the cylinders. But, in addition, some connecting rods, piston rods and boiler stays were sawed through, boilers were burned out by dry firing, and there was much minor vandalism.

The chief problem, however, was the repair of the broken cylinders, some of which were more than 9 ft. in diameter. The Bureau estimated that—with such facilities as were available for this heavy work—it would take at least eighteen months to replace the damaged cylinders by new ones. Meanwhile, there was bitter need of rapid transport for our troops to France. On the removal of that crisis, there seemed to depend the salvation of Christendom.

At this juncture, Captain Earl P. Jessop—then Engineer Officer

of the New York Navy Yard—recommended that repairs be made by welding, and, in this recommendation, he was heartily supported by Rear-Admiral George E. Burd, Industrial Manager of that Yard. The Engineer-in-Chief at once ordered Captain Oscar W. Koester, Assistant to the Bureau, to New York to investigate the situation fully. As the result of his report, the Bureau immediately issued orders to make repairs, where possible, by electric or oxy-acetylene welding, and where welding was impracticable owing to the location of the break, to resort to mechanical patching—that is, to "soft patches" which are secured by body-bound bolts.

From this stage onward, the repairs were supervised personally by Captain Koester, who, in his resourceful ability and driving power, is unsurpassed. His work went on night and day, and in five months he traveled about 14,000 miles in railroad trains from one Navy Yard or private plant to another along our Atlantic Coast. At the expiration of that period, his huge work was done and the ships were ready for service.

The rapidity of getting these ships ready for service was facilitated by one other action. On many of them, in addition to the damage done by vandalism, extensive repairs were necessary, owing to their deterioration from long idleness. As the necessary overhaul and all routine repairs could be made by a capable naval crew under able officers, the Engineer-in-Chief laid the matter before Admiral Benson, Chief of Operations, with the request that the ships be fully commissioned before repairs were begun. This was done, and thus, while the welding operations were in progress, the ships were prepared in all other respects for sea.

One other feature of this matter deserves comment, and that is the military value of this work in the transport of troops. These fifty ships were in service for about a year before hostilities ended, and this is approximately the time saved in these repairs by using welding methods. Twenty of these vessels can carry about 70,000 troops in one trip, and ten round trips a year is a conservative estimate of their performance. Representative Young of North Dakota, who crossed the Atlantic in the *Leviathan*, stated recently in the House that she had transported more than 99,000 troops up to August 20. So, it may be justly claimed that the rapidity of these repairs had a marked effect on the early end of the fighting in France.

LONG-RANGE HEAVY NAVY GUNS WITH RAILWAY MOUNT

By LIEUT.-COM. D. C. BUELL,[1] U. S. N. R. F.

THE history of the work done in completing a mobile battery of naval guns in record time for service in France forms a remarkable record, even in an organization as noted for great achievements as the American Navy.

Owing to a change in the characteristics of certain battle cruisers, a number of 14-in. 50-caliber guns, originally built for these ships, became available during November 1917 for other service.

It was felt that if these guns could be placed upon railroad mountings they would prove a valuable adjunct to our artillery forces, since they throw a 1400-lb. projectile at a muzzle velocity of 2800 ft. per sec., giving, at high elevations, an effective range of nearly 30 miles. They throw a heavier projectile with greater accuracy and to a greater distance than any gun previously placed on mobile shore mounts.

But little preliminary discussion was necessary before the plan to use these guns in a naval railway battery was approved, and on December 26 last the Navy Bureau of Ordnance instructed the Naval Gun Factory at Washington to prepare plans and specifications for the project.

The final plans and specifications not only for the mounts, but for the locomotives, cars, and other equipment necessary to form a complete land expedition, were completed in less than 30 days, being ready to submit for bids on January 25.

The plans and specifications called for five 14-in. railway gun mounts, six locomotives, and six complete trains of cars—75 cars in all.

On completion of the plans, proposals were immediately sent out by telegraph to the leading manufacturers of the country calling for an opening of bids on the morning of February 6.

The first bids were rejected because time of delivery was not satisfactory, but as a number of manufacturing plants had representatives present when bids were opened, a better understanding of the project was possible.

A second opening of bids was set for February 13. The result of this opening was very pleasing and the contract was awarded on the afternoon of February 13; and on the same evening the contractors began the work of gathering together the necessary material for the project. The date of delivery of gun cars and locomotives was set by The Baldwin Locomotive Works for June 15, and the Standard Steel Car Company undertook to deliver the cars and special equipment by this same date.

In spite of the fact that The Baldwin Locomotive Works, noted for making, perhaps, the fastest manufacturing schedules in the country, had set June 15 as their earliest date, Mr. Vauclain and his organization speeded up this project so that the first mount was completed and moved from the Baldwin shops on the morning of April 25, 72 days from the date bids were opened and 20 days ahead of the Baldwin schedule. This mount was taken to the Army Proving Ground at Sandy Hook for its test firing; the tests were entirely satisfactory.

The last of the mounts was finished and delivered on May 25, and practically all of the cars and special equipment delivered for shipment by June 1; hardly 100 days from the time bids were opened, and only 155 days from the time the project was first considered.

A very impressing feature of the work was that there was practically no change in design necessary during construction. The original drawings were final drawings in almost every case.

Army officers who viewed the tests of the first gun were so impressed with its performance and with the speed with which the project was being completed, that the Navy Bureau of Ordnance was requested to build for the Army three additional and identical mounts.

Requisitions were prepared and material ordered for these three mounts on May 18. The first Army mount was finished complete and ready for shipment on July 17 and the second and third on July 25.

When it was seen that the first three mounts built for the Army were nearing completion, the Navy Bureau of Ordnance was requested by the Ordnance Department of the Army, on July 18, to build another lot of identical mounts. Work on these second three mounts was pushed, and the first was completed on September 16, and the remaining two a few days later.

It is to be regretted that conditions were such that these mounts built for the Army were not shipped to France in time to be erected and put into active service.

The original understanding was that the Naval Battery would operate with the British Army. By April 15 enormous quantities of material had arrived at Philadelphia Navy Yard and shipment could have commenced at that time. On May 15, with the completion of the entire project no more than two weeks distant, and no definite decision from the British as to the shipment of the guns, due to the fact that the German drive had threatened channel ports, the expedition was offered to General Pershing for use with the American Army.

On May 23 General Pershing cabled, requesting immediate shipment of the entire expedition to St. Nazaire, France. The shipment of the equipment to France was delayed because of the fact that the German submarines, which operated on this side of the Atlantic, torpedoed the S.S. *Textile*, inbound to take the guns and

[1] Bureau of Ordnance, Washington, D. C.

Presented at the Annual Meeting, New York, December 1918, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

the girders to France, so that the first shipment was not made until June 20.

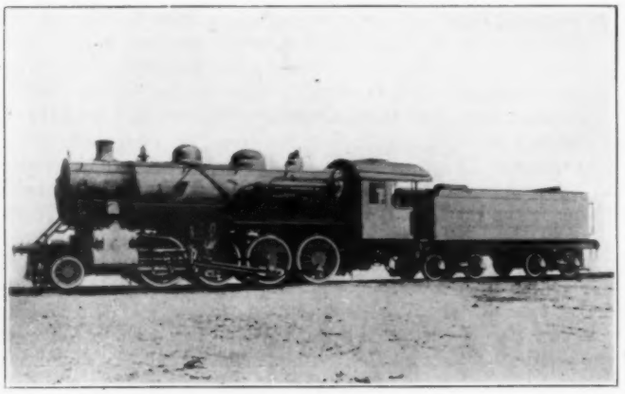

FIG. 1 ONE OF THE SIX LOCOMOTIVES CONSTRUCTED FOR THE RAILWAY MOUNT EXPEDITION
Weight of Locomotive 83 Tons. Weight of Tender 56 Tons

14. The last train left for the front on September 21, and arrived at the base on September 22.

The first gun was fied against the Germans on September 5—less than 250 days from the time the project was first thought of.

Too high commendation cannot be given to those who conceived this project. The entire equipment operated in a highly satisfactory manner, and practically without change from the original design. The question as to the guns being too heavy to transport over French railroads, proved groundless.

The pit which the French at first criticized, proved a very valuable feature when the guns were fired at a fixed target for any length of time.

It was suggested by the French that if a similar type of mount could be devised for use where it was desired to bring the gun into action quickly, it would obviate the only possible objectionable feature of the first mount. It is interesting to know that the Navy Bureau of Ordnance, anticipating this requirement, had already designed and was building another battery of 14-in. mounts before the armistice was signed.

These new mounts were designed to be fired directly from the track, at all elevations, without any preliminary preparation

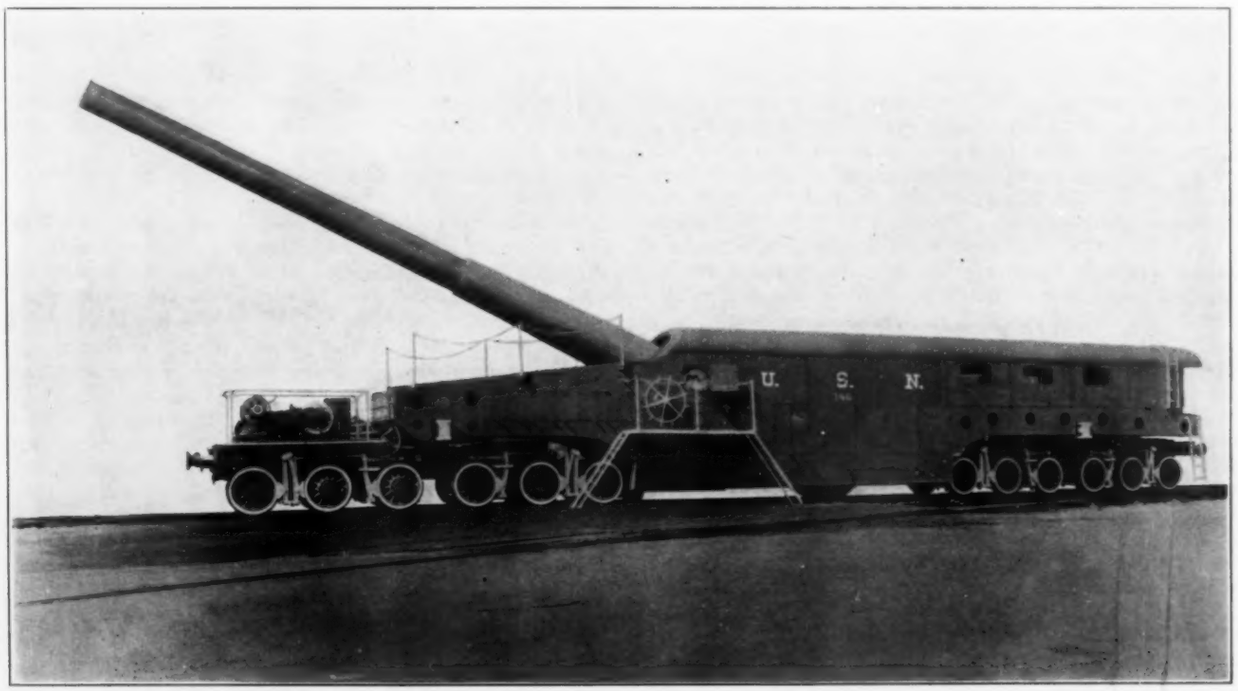

FIG. 2 ONE OF THE 14-IN. NAVAL RAILWAY GUNS DESIGNED, BUILT AND PUT INTO OPERATION BY THE BUREAU OF ORDNANCE OF THE NAVY DEPARTMENT

This first ship was followed by two others on July 4. The final shipment of spare parts, extra guns, etc., was made on July 21.

Anticipating the need of skilled men for erection work in France, 200 experienced railroad mechanics and operating men were selected from the 40,000-odd bluejackets at the Great Lakes Naval Training Station, and sent to France a little before the first ships of material sailed.

The first shipment arrived at St. Nazaire on July 8; the second and the third on July 21.

The locomotive and car erection began July 20. The erection of the first gun was begun July 30. The first gun train was completed and ready to leave St. Nazaire on August 11. The first two gun trains left for the front on August 17 and 18, respectively.

The first gun mount was ready 12 days after the girder was unloaded from the ship. The first two trains were ready 22 days after erection work started.

Trains 3 and 4 were completed, equipped, and loaded September 12; train No. 5 on September 13; and train No. 6 on September

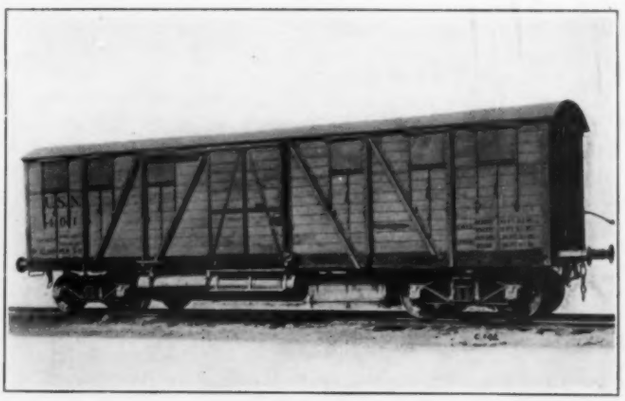

FIG. 3 ONE OF THE 75 CARS CONSTRUCTED FOR THE RAILWAY MOUNT EXPEDITION

whatsoever; had they been required they would have been ready to ship to France by February 1919.

As far as can be ascertained, there were no finer or more accurate-shooting guns in the war than these first 14-in. mounts.

Had the new mounts been added to and consolidated with the first expedition, it would have been difficult for any nation to have conceived and executed a finer battery of guns than the U. S. Naval Batteries.

After the reading of his manuscript Commander Buell showed some slides and a reel of moving pictures illustrating the details of working out the project. At his request Mr. George A. Chadwick, Mem.Am.Soc.M.E., the designer of the gun, then gave interesting particulars regarding weights, reactions, dimensions, etc., which are embodied in the following paragraphs.

Figs. 1 to 5 give a slight idea of the magnitude of this work. The gun complete weighs about 550,000 lb. The shells weigh nearly 1500 lb. each and the powder charge for a shell 484 lb.

There was considerable question as to what would happen when the first gun was fired, and some of the spectators even suggested where the girder would break in two. Nothing happened, however, and the work was continued without any difficulty.

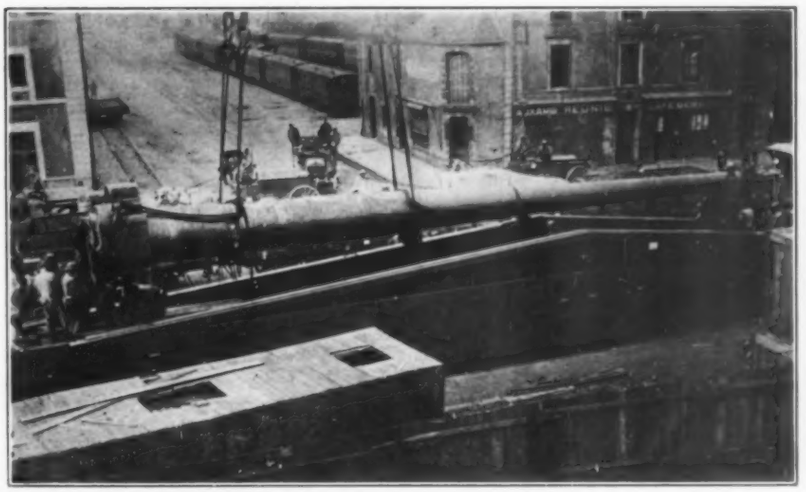

FIG. 5 PLACING GUN ON GIRDER FOR TRANSPORTATION TO SHIP

The gunwork was adapted to the mount with very little change from battleship design. This allowed the use of considerable material that was on hand. A view of the girder is shown in Fig. 3.

FIG. 4 A GUN GIRDER UNDER CONSTRUCTION IN A U. S. NAVAL GUN FACTORY

The truck axles were designed to withstand a maximum axle load of 63,000 lb. The kinetic energy of the gun is about 4,000,000 ft-lb., which is absorbed through a hydraulic brake in the recoil of 44 in. in the slide, and when firing on the rails the movement to the rear along the tracks is about 26 ft. When firing from a pit the load is transmitted to foundation members in the form of a heavy grillage construction of castings and structural-steel shapes, the load being limited to about 4 tons per sq. ft., which so far has been found to be satisfactory.

Some idea of the difficulties which arose in assembling the guns and locomotives on the other side may be gathered from the fact that it is necessary to have everything on the ground before starting to build. For this reason the material piled up in an unbelievable manner. Two switching engines had to be working day and night removing loads to the yard, unloading them with the crane and making the various moves necessary to clear up the work.

THE ENGINEERING OF MAN POWER

Keynote Sessions of the Annual Meeting. Papers and Addresses of Vital Interest

IT was quite evident from the attendance, the general interest and the lively discussion which attended the reading of papers on Thursday morning and afternoon at the Keynote Session of the Annual Meeting of the Society that the Committee on Meetings had arranged a program which was in accord with the present trend of affairs in the industrial world as well as in society at large. That the Engineering of Man Power should have become the subject of a keynote session of The American Society of Mechanical Engineers is indicative of a point of view of that very perplexing problem of industrial relations which the war, and particularly the closing of the war, has forced upon a newly-awakened consciousness in the world at large.

OPENING ADDRESSES BY DR. IRA N. HOLLIS AND DR. L. S. ROWE[1]

The morning session was opened by the Chairman, Vice-President Plunkett, who introduced Dr. Hollis, Past-President of the Society, who had been asked by the Committee on Meetings to make the introductory remarks. Dr. Hollis recalled the incident of a year ago when members of the Society stood with bowed heads in prayer that the war upon which America had entered would be victoriously ended before a year had passed. A modern miracle, he said, had been performed by America in sending across the seas two millions of men—two millions of every nationality, fused together in the melting pot which is America and united in a common purpose and forming the finest army, morally, known to history. When these men return, he asked, are we going to measure up to their ideals of what America ought to be?

The old estimates of other countries of a dollar-mad America had been shattered by this war, as was evidenced by the free-will contributions of enormous sums to the Red Cross, to the United War Work Campaign and to other causes. "I believe," he said, "that there is one phrase which expresses American ideals,

[1] Assistant Secretary of the Treasury, Washington, D. C.

and without which none can ever understand America. . . . Service to Man. I would put that forth as the motto of America —Service—and anyone who interprets our civilization . . . through that one word will have a complete understanding of American ideals. The changing character of the papers presented in the past ten years before the Society is an indication of an appreciation and understanding of true American ideals, for as we study them, we find that they have turned more and more toward an exposition of the opportunity of the engineer to serve mankind."

Dr. Hollis' address was followed by one by the Assistant Secretary of the U. S. Treasury, Dr. L. S. Rowe, who spoke on The Engineer in Foreign Service. Dr. Rowe refered to his observations of American and other engineers in the countries of Central and South America where he had spent much time and pointed out some of the failings of the American engineers. These were not, he said, because of lack of training, or any lack of grasp of principle, or lack of inventive genius or ability to meet new situations, but because at times American engineers in foreign service do not as fully appreciate the larger responsibilities and the larger representative capacity which they must assume when engaged in great public works abroad.

One defect, said Dr. Rowe, was a certain impatience and unwillingness to make a real effort to teach a native population how to become efficient laborers. The engineer may exploit labor, or he may perform a great economic service to the country in which he is operating and create ties and influences which will be an important factor in determining the general attitude of that country toward America. In so doing the engineer is performing a diplomatic service for the United States. A further shortcoming of the American engineer abroad is his impatience to return home. The American engineer, like the American banker, or salesman, does little to learn the language or to make local acquaintances or to get into a closer contact with the people of the localities in which he is operating.

There is no representative who touches the life and progress and well-being of a country as closely as the engineer, and therefore it is of vital importance that in the early training of an engineer everything should be done to prepare him for foreign service. He should know considerable of economics, of government; and he should learn a language with a greater degree of thoroughness than he learns at present in our universities. He should be encouraged in foreign travel to the extent that he might have the benefit of a scholarship for that purpose. Thereby a group of engineers might be trained for foreign service. Here rests a great national responsibility on the engineering profession.

Dr. Rowe's address appears in more complete form elsewhere in this issue.

Industrial Organization as It Affects Executives and Workers

Charles E. Knoeppel then presented his paper, Industrial Organization as It Affects Executives and Workers.[1] From a studious survey of his experience as an executive the author emphasized as essentials in the formulation of definite laws of organization: The necessity of having an objective in the mind before beginning to work; the exclusive concentration of each man to definite functions; the avoidance of confusion and conflict of authorities; the proper division of departments in order to insure that each executive has complete control of all the factors affecting the success of his function; the creation of divisions which will develop specialists; the provision for permanency by training men to fill the positions of their superiors; the exact definition of the duties of each employee and of his relations to the others; the logical selection of personnel according to individual qualifications; and the creation of a standard manufacturing practice.

Valuable suggestions were also given in regard to the question of establishing an efficient administration. Delegating authority to subordinates, overlooking minor details, listening to wise counsel and arousing initiative in employees were recommended as important points in the exercise of industrial authority.

In a written discussion of Mr. Knoeppel's paper, John F. Grace said that the 15 conditions stated in the paper were almost axiomatic, but that their application was a gigantic task for executive genius. To this end, pictures and graphs should be applied as in the manner of good advertising to instruct the workers, rather than texts. The lack of definite instruction to each worker, which had been mentioned as a major cause in the breakdown of organizations, seems largely due to the inability of managers or systematizers to define and isolate duties which are constantly overlapping. Any radical change of system affecting the majority of workers should be explained at a general meeting of the employees of the department or plant affected, by someone who understands the object and method.

C. W. Johnson, in an oral discussion, spoke of the keynote of justice, fairness in an active way to every individual in the organization. A. C. Fleckenstein[1] said that engineers engaged in production could help immeasurably the advance of industrial and efficiency engineering methods by creating in the mind of the owner of the plant a proper regard for the services of the apparently non-productive industrial engineer, an investment in whose services would render a large financial return.

Standardization and Administration of Wages

A paper by Earl Dean Howard[2] and Henry P. Kendall entitled Standardization and Administration of Wages, was read in abstract by Secretary Rice in the absence of the authors. The paper first gives particulars of the administrative machinery available before the war for dealing with industrial relations, and then of the governmental agencies since developed for that purpose. The authors then set forth certain general principles which they believe should be followed in dealing with labor problems in the future. The term standardization does not necessarily mean uniformity of wages, hours or conditions of work, but the determination of these conditions according to general principles, the justice of which is universally acknowledged. Say the authors: "The regulation of industrial standards by joint boards as suggested has the great advantage over the present system in that it eliminates at least three-fourths of the cost of friction between the particular employer and his employees. Each employer then adopts the standards which are current in his trade and knows that all his competitors are on the same basis and have no advantage over him. Even under our present system, the chief objection to any one employer's increasing wages lies in the fact that it comes out of the profits unless the increase is general among his competitors, when it is shifted to the consumer of the product. It is easy to foresee a time when the public and not the employers will have the chief interest in opposing wage advances."

Standardization is increasing in the larger industrial establishments. The administration of industrial relations, especially by a skilled person specialized for the work is no longer an experiment. It is reasonable to expect that organization of employees, fostered by the employer and given full opportunity to function legimately in matters which touch the interests of employees may develop into constructive agencies whose criticisms and suggestions may be of great value in improving the efficiency of the business. To make this plan truly successful, however the management must decide to give labor a fair share of the efficiencies and economies realized.

A further abstract of the paper is given later in this report.

In discussing the paper, H. F. J. Porter spoke of the work which Mr. Howard had done in introducing in many industrial plants methods of bringing employer and employee together with a representative of the public. These methods have been introduced into New York in the cloak and suit industry, composed of some 80,000 employees. On the Board of Control organized for the consideration of questions arising out of industrial relations are

[1] For abstract of paper see December JOURNAL, p. 1031.

[1] Richmond Radiator Co., New York City.

[2] Executive Secretary, Committee of Industrial Relations, Washington, D. C.

represented a group of labor unions and a group of manufacturers. These two elect a representative of the public. In large industries today there are many such organizations. A meeting to discuss the merits of this type of organization is being planned in conference with Mr. Howard, Frank P. Walsh and Hon. William H. Taft. This conference will probably result in a public meeting to put before the people of the country the work of these organizations and their recommendations.

Non-Financial Incentives in Industry

The last paper scheduled for the morning was by R. B. Wolf on Use of Non-Financial Incentives in Industry.[1] The sincerity and earnestness of Mr. Wolf's words won for him the admiration and approval of his audience, awoke in them an uncommon interest and stimulated an inspiring discussion which had to be carried over into the afternoon session, thereby delaying the afternoon schedule by fully two hours. Mr. Wolf confined himself to the subject of non-financial incentives to an extent which led some of his hearers to imagine that he had no faith in financial incentives, a misunderstanding which was subsequently cleared up by the speaker. That man does not do his best work for hire was Mr. Wolf's basis for the non-financial incentive; that is, interest in work, "the joy of the working." His plea was for the utilization of the creative agencies of labor; and to prove the practicability of their utilization he gave examples of what had been accomplished in mills under his management where interest in the work had been stimulated by "progress" records of individuals and by an appeal to the natural intelligence of the workman. To quote from a closing paragraph of the paper: "We should never lose sight of the fact that the degree of conscious self-expression which the workman can attain is in direct proportion to the ability of the organization to measure, for his benefit, the impress of his personality upon it. The most democratic industrial plant, therefore, is the one which permits the fullest possible amount of individual freedom to each member, irrespective of his position, and at the same time is so sensitively adjusted that it reflects immediately the effects of his actions. If his actions result in injury to others he will see that as a part of the whole he, himself, must also suffer."

The discussion of the paper was opened by Walter N. Polakov, who took occasion to warn the members that they should not get the impression that financial incentives were not important or even superfluous as long as non-financial incentives are at work. To illustrate his point he showed on the screen three charts indicating the preventable losses in a power plant. In chart 1, with neither financial nor non-financial incentives, the loss amounted to over 30 per cent. With non-financial incentives at play in chart 2, the loss had been reduced to 17 per cent, while in chart 3 with both financial and non-financial incentives at work the preventable losses had been wiped out. W. E. Pulis showed some slides of a similar nature in which the same facts were represented. Later in the afternoon, in reply to Mr. Polakov, Mr. Wolf said that the reason the non-financial incentive records shown by Mr. Polakov did not show as great a saving as was shown when a bonus was attached was because he had not tried the plan of giving the men the record of their accomplishment without the bonus attached to it. Without deprecating bonuses entirely, Mr. Wolf was of the opinion that they should be carefully considered. Men both union and non-union had said to him, "We don't like to be bribed to do a good job. We would like to have the privilege of doing a good job without being bribed to do it."

Irving A. Berndt,[2] in a written discussion of the paper said that he was particularly impressed and in accord with what Mr. Wolf had said concerning the necessity of providing workers with environments which attract, and providing incentives inherent in the nature of the work itself. This was fundamental and basic. "Were I to add any thought to this," he said, "it would be that the responsibility for this lies with the individual employer, manager and executive and should under no circumstances be passed on to society or to the worker himself."

Being confronted with the problem of reducing supplies taken from storerooms in a large plant—supplies used for maintenance and repair—Mr. Berndt found it possible to secure interest among the men calling for them by placing at the storeroom window a list of current prices and a weekly bulletin telling how much the supplies used by each man or group had cost, comparisons being given. The two simple records stimulated interest and the desired result was secured. He had never found a foreman, he said, unresponsive to confidence placed in him by showing him records of costs, performances and even profits. He would not consider a monetary incentive properly applied unless it included a plan for keeping each man advised of current progress and also giving him a written statement of results.

Afternoon Session—Continued Discussion of Mr. Wolf's Paper on Non-Financial Incentives

The session of the afternoon was presided over by Vice-President John Hunter, who called for additional discussion of the Wolf paper. Henry L. Gantt said that the paper was an important contribution because it emphasized democracy in industry, and also that there could be no democracy in industry unless there was common knowledge of what was going on. Mr. Wolf had obtained remarkable results by letting every man know what he was doing and what was expected of him. It was too often true that the employer did not know exactly what his employees were to do. The discussions of Messrs. Polakov and Pulis had indicated what could be accomplished when it was known exactly what men should do. In settling the problems confronting employer and employee each concern is going to solve its own by knowing more about the conditions in its own shop and what is hampering the workmen there.

Richard A. Feiss thought that there was danger of interpreting Mr. Wolf's paper as a condemnation of financial incentives. Both financial and non-financial incentives have their place and must be taken into consideration. There are no cure-alls in industry, and failures in the application of so-called efficiency methods have grown out of a loss of perspective. The object, after all, is to obtain the best possible result from the human element in industry, and that involves a psychological question. The problem of employment will be solved only by maintaining a broader vision, by remembering that the human being is a human being and must be studied from all points of view and under varying conditions. He said that Mr. Wolf's paper called attention to a single element in management and that it, with all the other elements under the existing situation, must be taken into consideration when dealing with the complex psychological question of industrial relations.

A. L. De Leeuw said that the lasting growth of labor can only be caused by making labor grow from the inside out. The effort must be made by the laboring man, and not by the employer. The employer has only helped labor in general, but has not caused it to grow. Labor has taken the stand that it can grow only by antagonizing the employer, who, at one time, held this same view of labor. Something should be done to make labor start a growth or development of itself in the proper direction. If labor has not seen these facts, should not some one hold out the hand and invite labor to move in the right direction? Has not the time come when the engineer should get in touch with labor and invite it to discuss labor questions from a standpoint of pure and simple engineering, dropping all ideas of malice, and presenting the idea that a true bargain is one which benefits both parties? "Should there not be a third party," he said, "more or less disinterested, or rather, interested in the welfare of both, who will hold out the hand to labor and invite it to develop itself, to make an organic growth from the inside outward? Would it not be well if some engineering society were to invite labor into its counsel and see that a proper organized effort can be made for labor to look at the questions, not only of its own development, but of the development of industry as a whole, making labor to realize that no real benefits can ever come to it and be lasting unless similar benefits come to the industry as a whole?"

Charles Whiting Baker brought out the point of the reaction upon the wage earner through the increased cost of living of the

[1] See the December JOURNAL, p. 1035, for abstract of paper.

[2] Care of C. E. Knoeppel & Co., 101 Park Ave., New York City.

inflation of wages. He was followed by Hugo Diemer, who emphasized the same thought, saying that the understanding of these economic principles presupposed education of the worker, of the engineer and of the general public. He spoke then of a course in Industrial Engineering which for a number of years has been given at the Pennsylvania State College and in which it is attempted to bring out some of the human phases of engineering. His remarks were a defense of the teaching profession, and in answer to the general criticism that engineers lack training in these less mathematical and technical phases of their profession.

John Clinton Parker said that the non-financial incentive applied to himself was to build up something that would be a credit to him, and that this was an incentive which applied to every one. He was also impressed with the fact that the solution of the problem of labor was endangered by a lack of faith and a false notion of elementary economic principles.

Frank B. Gilbreth spoke of the changed conditions which were confronting industry with the close of the war. Where a soldier was returning to his former job, now held by someone whom he considered his inferior, he found that more work had been accomplished than he had been accustomed to do and that greater productive effort was to be required of him in the future. So true was this in Europe that it has resulted in the eliminations of all restrictions upon output. The realization has come that the salvation of the world lies in big outputs per man. Engineers and economists have known this for some time, but laborers have not. They have held an honest belief that restricted output was the one thing which assured every man his job. They are not going to believe this any more because the labor leader knows that it is not true. Further, the laborer will not only release all limitations upon output but he will use his craft and skill to increase output. The workingman's committee is operating in a number of places as yet unannounced and with remarkable results. They are not interfering with the management in obtaining intensive outputs but are working on such things as heating and ventilating, elimination of labor turnover, the selection of the right man for the right place, fatigue elimination, education and corporation schools.

Arthur C. Jackson drew attention to the law that investment is entitled to an income. The investment may be in the form of cash, of invention, of accumulated earnings or of the results of the continued services of an employee. There should be a standard way of measuring all of these investments, and it is the duty of the engineer to solve the problem of the fair division of the profits resulting from these investments. Wealth is not alone dependent upon money but in the end upon production. This country must continue to be an exporting country if it is to maintain its position in the countries of the world. We can only maintain a wage scale above that of our competitors by the proportion that our production exceeds the production of our competitors.

Arthur L. Williston expressed the fear that the interest stimulated in an employee by teaching him how to perform his job properly would begin to lag after the attainment of the desired degree of perfection became an old story. He considered that the employer should have a new and greater lesson to teach as the simpler ones were mastered, looking upon his workmen as progressing from stage to stage in his industry as a student progresses in college from one class to another.

In his closure Mr. Wolf said that in his plants there was no difference between capital and labor. They were all fellow-workmen. He explained how he secured the spirit of coöperation with his employees by appealing to their intelligence and sense of justice, adjusting their wages by conferences, etc. He said that the men were promoted throughout the plant in much the same way as men progress through an educational institution. He contended that there was never trouble to be had with labor if the employer went to labor in a frank spirit of open coöperation. He thought that labor leaders realize that the workman must stop focusing his attention upon the distribution of wealth and focus it upon the production of wealth, after which the compensation would surely come.

In reply to some questions from Spencer Miller, who thought that the speaker might have contradicted himself in saying that men were rewarded by promotion and also that the incentives were non-financial, Mr. Wolf once more made the point that men do not do their best work for money. "It is the record, it is the accomplishment of the man that counts, and it is fundamentally self-expression that the man wants." The financial reward is bound to follow, and the employer who gives a man a chance to use his brain power and does not give him the financial compensation that goes with it is doomed to failure.

In answer to a question as to the disposition of the saving due to the improved efforts of employees, Mr. Wolf was of the opinion that the money should be divided, that the men should be part owners of the industries. It has been because workers have not worked intelligently that employers have been able to deprive them of this division of profit. The employer has used his brain to exploit the employee; the employee first used his brain to organize against the employer. That employee must be induced to use his brain for productive work. Then he will realize, as his mental capacity increases, that his reward is bound to follow.

Accused good-naturedly by John Clinton Parker of being a labor leader, Mr. Wolf replied that all engineers were labor leaders in the big sense of the word. Some one had said that the labor problem must be worked from within outward. The point of view cannot be imposed upon the laboring man. "The greatest potential force that exists in this country today for constructive leadership and disciplining of the destructive elements is organized labor. . . . Because there is a certain esprit de corps among them, so that, if you can get them harnessed into the partnership in a constructive way, get them focused upon the production of things, the power is tremendous."

Spencer Miller delivered a vigorous and inspiring address appreciative of the awakening which had come with the war and which had been the spirit of the papers of the day, and ended by proposing a vote of thanks from the Society to Mr. Wolf.

Robert L. Sackett amplified the remarks previously made by Hugo Diemer with reference to the courses in industrial engineering at the Pennsylvania State College, and was followed by Prof. A. G. Christie who, in the absence of Charles Piez, read his paper entitled The Evolution of the Organization of the U. S. Shipping Board, Emergency Fleet Corporation, which appears later in this report.

Discussion of Paper on Employment of Labor, by Dudley R. Kennedy [1]

In presenting his paper, Employment of Labor, Dudley R. Kennedy [2] said that he had been in the business of employing labor for eight years, and was considerably impressed to hear such a discussion of the subject of human engineering as had taken place that day. He wondered if, in the newly awakened interest in human engineering we were not turning to the frills in a sudden desire to conquer the problem. Collective bargaining to him did not mean dealing with a labor union or the one labor union of this country, but dealing with the people of his factory collectively. He could not agree with many economists with regard to the cost of living, but felt that the raising of wages in and of itself continually raised the cost of living, and the man with a short pay envelope never quite caught up. He insisted that if industrial relations were to be studied in a plant, the man to do it should be the best man money could procure, and not some clerk who had read a book on management. It required the best brains available.

L. W. Wallace, discussing the paper, emphasized this same point. Robert G. Wells was equally certain of it. He said the problem of getting labor and of maintaining an adequate and efficient force was just as large as any other industrial problem and was deserving of a department reporting directly to the head of the organization. He hoped the day would come when we would cease to use the terms "labor" and "capital."

[1] See December JOURNAL, p. 1030, for abstract of paper.
[2] American Internat'l Shipbuilding Corp'n, Hog Island, Philadelphia, Pa.

Just as business men had found that their competitors were their best friends, so labor and capital should regard one another and coöperate.

Intensive Training by the Committee on Education and Special Training

Mr. C. R. Dooley[1] then read his paper on Intensive Training. The Committee on Education and Special Training was appointed to train drafted men as specialists in required trades. The program outlined by the Committee and the methods followed by them in carrying out their work were briefly described in this paper.

It was considered that the first essential step in educating the men was to accustom them to military obedience and discipline. Their classification was not based completely upon their past experience, but consideration was also given to their latent native abilities. Lastly, and the most important, the program of the Committee called for stimulating and fostering the qualities of originality and initiative. It was pointed out that the Committee was still capable of doing valuable work in training the returned soldier for industrial work during the process of demobilization.

James W. Russell,[2] in a written discussion, spoke of the work which had been done in the intensive training of boys and women at the plant of the Curtiss Aeroplane and Motor Corporation. A balcony was cleared and at least one machine tool of the same general character as those used in the shop set up for the "school." After a few weeks' training the pupil was sent to the shop. It was found that every person who entered for training was fitted for some one of the various divisions in the school, change within the school being a simple matter when the adaptabilities had been studied. In six months, 1500 employees were promoted to various departments of the plant. It was found that the selection of the instructor had to be done carefully, as it was necessary that he have not only a good character and a skilled knowledge of his trade, but also an ability to instruct.

In a written discussion, H. E. Miles[3] said that usually the powers of the individual man drawn upon did not exceed forty or sixty per cent of his possibilities, leaving a great reservoir untapped. The war had taught us to utilize this. It had taught us to train in six weeks where years were needed formerly in the wasteful apprentice system. He believed that the value of the practice of intensive training taught by the war has been proven in many factories and was about to be accepted as a part of the essential production program of every first-rate shop.

A. A. Potter wrote: "The work of the War Department Committee on Education and Special Training will result in the establishment of intensive short courses at many of our colleges and universities for the purpose of training industrial workers, who for lack of time on account of insufficient means are unable to devote more than a few months in preparing themselves for their life work."

He felt that the following factors contributed to the success of the Committee's scheme:

1 The men were prepared for a definite need
2 The courses were carefully supervised and the stress had been laid on the necessity of teaching men and not subjects, upon the desirability of building up a man's experience and ability
3 The men were taught by doing. The concrete preceded the abstract and the student saw the practicability of such instruction.

For work of this character to be successful in peace times, an industrial incentive must be developed to take the place of the war incentive. This can best be accomplished if the various industries tell the educational institutions their needs and allow the institutions to train men for a definite job.

A. B. Segur[1] mentioned in a written communication the work of Frank Gilbreth at Fort Sill in studying the motions of infantry and artillery for the instruction of officers in conducting themselves in the field. He said the Red Cross Institute for the Blind was availing itself of intensive methods of education in its work of fitting blinded men for well-paid positions in the industries.

Arthur A. Reimer, discussing the paper orally, said that what Mr. Dooley had done with the training of the army showed the possibilities latent in our nation—possibilities to be developed by our engineers.

Arthur L. Williston was impressed with the fact that what Mr. Dooley had been doing was the basic purpose of scientific management: to determine the right process, to select the right man, to educate the man to do the job in the right way and to create in that man the maximum incentive. All the way through the discussion of management too much emphasis had been placed upon the right process and too little on the selecting of the right man, the training of that man, and the creation of the incentive.

In the absence of F. A. Waldron, his paper, Labor Dilution as a National Necessity,[2] was read by title, and the reading of a written discussion by Charles E. Fouhy[3] omitted because of the lateness of the hour.

THE ENGINEER IN FOREIGN SERVICE

By HON. L. S. ROWE,[4] WASHINGTON, D. C.

I HAVE come to you to take counsel at this critical period in our nation's history with reference to a national and international service which you, the engineers of the country, are in a position to perform. The winning of this war carries with it heavy responsibilities, especially for the United States. Our entry into the conflict has been free from all selfish purposes and has been prompted by a spirit of service to humanity. It is for you and for me, as citizens of this country, to see to it, in our respective fields of activity, that these high standards and that these high purposes shall not remain empty words. The engineering profession can boast of a splendid record of achievement. My plea is rather for the broadening of this spirit of service in order that a larger proportion of your profession shall be equipped to serve in foreign lands and particularly our sister republics of America, in the great engineering problems which confront them.

These problems have a deep significance for the future of America. Upon their solution depends to a very considerable extent the degree to which large sections of the American continent shall be made habitable, and beyond this, the extent to which the republics of Central and South America shall fulfill the great possibilities which are before them. It is not merely a question of the development of the natural resources of these countries and their consequent increase in wealth. Larger social purposes are also involved, for with the development of these resources the condition of their laboring population will be materially improved. It is a notable and significant fact that each great engineering work in Latin America has brought with it a rise in the standard of life of considerable sections of the population.

I have seen American engineers at work in almost every part of the American continent, and I have been impressed not only by their technical preparation and ability, but by the broad statesmanship that they have shown in the handling of large masses of foreigners and in their dealings with foreign governments. But the number available for the work has been entirely too small, and I am firmly convinced that in order that the United States may constantly have an engineering reserve to meet the needs of this continent, it will be necessary to broaden the training of the engineer in order that he may set forth with something more than the technical equipment of his profession.

The opportunities presented to the engineer in the countries of Latin America, both pecuniary and from the standpoint of

[1] Educational Director, Comm. of Education and Special Training, Washington, D. C.
[2] Curtiss Aeroplane & Motor Corp'n, Buffalo, N. Y.
[3] Chairman Section on Industrial Training, Council of National Defense, Washington, D. C.

[1] Industrial Engineer, Red Cross Institute for the Blind, 1060 Conway Building, Chicago, Ill.
[2] See December JOURNAL, p. 1033, for abstract of paper.
[3] Curtiss Aeroplane and Motor Corp'n, Buffalo, N. Y.
[4] Assistant Secretary of the Treasury.

recognition, are so great and so varied that all that it will be necessary to do will be so to adjust the preliminary training and equipment of students of engineering that they will be prepared to avail themselves of these opportunities. In order to do this it is indispensable that a larger percentage of our engineers leave the engineering schools with an adequate knowledge of the Spanish language. This is the first and an indispensable requisite. There should also be instruction in Latin-American political institutions in order that the engineer may know something of the system of government in the country with which he is to be associated. But beyond these questions of technical equipment we must instil into the mind of every engineer the larger international service which he is rendering when he undertakes a great work in a foreign country, especially if such work is undertaken for the government of the country. This means a greater breadth of view combined with a certain cosmopolitanism which will assure ready adaptability to new conditions and to new requirements.

During repeated and extended tours through South America I have time and again been asked to assist in securing the services of irrigation engineers, electrical engineers, engineers for the designing and erection of public works and other important public enterprises. There has been no difficulty in finding men equipped to do such work, but there has been a very real difficulty in finding American engineers prepared to expatriate themselves for a period of years in order to undertake such work and to carry it to successful conclusion. In spite of our cosmopolitan make-up there is a lack of adaptability of the average American in adjusting himself to foreign conditions, which makes it exceedingly difficult to secure men who are willing not only to begin, but to complete large public works in foreign countries. This has been true not only in engineering, but in every other field of endeavor. American commission houses in South America must engage Swiss, Dutch and even Germans because of the unwillingness of American employees to settle down in those countries for any lengthy period. Almost every American that I have met serving in a foreign country feels that he is making a great sacrifice in consenting to expatriating himself even for a relatively short time. At the end of about six months he begins to show signs of impatience and at the end of a year his homesickness reaches a point which at times leads him to leave his work incomplete. Furthermore, there is too often a failure on his part to place himself in touch with the people of the community in which he is living and he thereby fails to exert the broader influence which would be of such great value to his country.

This defect has been less marked in the engineering profession than in any other. What we need first of all is a clear conception of the very real international importance of service in foreign countries. I am convinced that if the entire engineering profession were to realize the extent to which its members can serve in promoting the spirit of international coöperation which the President has placed before us in such eloquent terms, greater effort would be made in preparing and encouraging members in that profession to respond to the call, especially when such calls are made by our sister republics of this continent.

It is important, however, to bear in mind that whenever a member of your profession undertakes the supervision of a public work in a foreign country, he becomes in a very real sense a representative of the people of the United States. He must be able to understand the viewpoint of nations different from our own in historical and ethnic make-up. The engineer in charge of great public works has often under his immediate direction great masses of native labor and it is most important that he should show a real interest in their welfare, contributing within the measure of his power toward the increase of their efficiency and the raising of their standard of life. In a hundred different ways the members of your profession can make themselves factors of very real importance in the progress of the countries which they are called upon to serve and at the same time become to the people among whom they are called upon to labor the interpreters of the best in our American life. The responsibility is a heavy one, but the magnitude of the results is commensurate with the responsibility.

ORGANIZATION OF THE U. S. SHIPPING BOARD EMERGENCY FLEET CORPORATION

By CHARLES PIEZ,[1] PHILADELPHIA, PA.

THE United States Shipping Board was created by Act of Congress, approved September 7, 1916, "for the purpose of encouraging, developing and creating a naval auxiliary and naval reserve and a merchant marine to meet the requirements of the commerce of the United States, with its Territories and possessions, and with foreign countries; to regulate carriers by water engaged in the foreign and interstate commerce of the United States; and for other purposes." The Shipping Board, under the provisions of this Act, was given the power, if in its judgment such action was necessary, to carry out the purposes of the Act, to form under the laws of the District of Columbia, *one* or *more* corporations for the purchase, construction, equipment, lease, charter, maintenance and operation of merchant vessels in the commerce of the United States, and in the exercise of the power so granted the United States Shipping Board Emergency Fleet Corporation was organized on the 16th day of April, 1917, with a capital stock of $50,000,000, all of which has been subscribed for by the United States Shipping Board on behalf of the United States. As the Shipping Board is, under the Act, charged with the responsibility of doing all things necessary to protect the interest of the United States in the Emergency Fleet Corporation, it has elected to place the control of the Corporation in the hands of a Board of seven Trustees, five of these Trustees being the five Commissioners composing the United States Shipping Board.

It is evident that by this method of control the vast responsibilities which the war has created rest in the final analysis upon the five Commissioners of the United States Shipping Board. And when it is remembered that these gentlemen have been confronted with the task of blazing new trails and establishing the fundamental policies in connection with the giant tasks of regulation, construction and operation, the troubles which made the early days of the Shipping Board a byword find ready explanation. Relief from this over-centralization of responsibility and control could, of course, be secured through the exercise of these three main functions by three separate but related and centrally controlled bodies, and the Act itself provides for just such a solution.

When Mr. Hurley took office, the by-laws of the Fleet Corporation provided that the officers were to be a President, a Vice-President, a Treasurer, a Secretary, a General Manager, and such other officers as the Trustees might determine. They further provided that the General Manager should have the general oversight and management of the business and affairs of the Corporation, and should have power to employ and discharge all clerks, employees and agents, determine their salaries, and prescribe and define their duties. In other words, the titular head of the Corporation was assigned merely nominal powers, and the General Manager, who is usually an appointed officer, was given full executive control and responsibility, but yet lacked the power to complete contracts, a most important and necessary function for speedy prosecution of the work in those early days of pressure and stress.

The Denman-Goethals controversy arose quite naturally out of this faulty scheme of organization. Mr. Hurley improved this condition tremendously when late in November the by-laws were amended so that complete power was concentrated in the President of the Corporation, with the authority to delegate it, and the General Managership was made an appointive instead of an elective office. But, in spite of this wise and necessary step, the process of decentralization above outlined would have improved the administration of both the constructing and the operating division and would have relieved mightily the pressure on a much overloaded Board.

The relationship and functions of the United States Shipping

[1] Vice-President and General Manager, U. S. Shipping Board Emergency Fleet Corporation.

Board and the two divisions of the Fleet Corporation are shown in Fig. 1.

In the popular mind the Construction Division is considered the Emergency Fleet Corporation, and as it is to the Organization of this division that this article will address itself, I will follow the popular misconception and refer to this division as the Fleet Corporation.

The Corporation began in reality as a designing and contracting organization, and for the first four months of its existence these two functions overshadowed all others. On August 3, 1917, however, all vessels in American yards, under construction or contract for either domestic or foreign account, were requisitioned, and this step brought with it the control of the construction of 413 vessels, necessitating the addition of a division of construction to the skeleton organization then existing.

But the country's needs for ships could not be satisfied with the output of the shipyards then existing, and substantially every one of the earlier contracts for vessel construction carried with it the obligation of constructing wholly new facilities. Designing vessels and contracting for their construction, which constituted the first phase of the Corporation's work, was quite naturally followed by plant and shipyard construction as the second phase. In the meantime, however, the demand for war supplies was making heavy inroads not only on the available stocks, but on the producing capacity of the industries as well, and the Emergency Fleet Corporation found itself compelled to assume increasing responsibility for furnishing all of the new yards, and many of the old ones, with the necessary raw and finished material.

In the construction of wood steamers, only a few yards, for instance, accepted contracts for the delivery of complete ships, the remaining yards undertook the construction of wood hulls only, for which the Fleet Corporation had to provide not only the lumber and fastenings, but the chains, anchors and other hull accessories as well. The Corporation had to furnish in addition the boilers, piping, engines, propelling machinery, deck machinery and all other parts of the equipment, and had to construct separate plants at which this machinery and equipment could be installed on the hulls delivered by the hull contractors.

As the construction program developed it became evident that the two main problems confronting the Corporation consisted in securing an adequate supply of labor and an adequate supply of material delivered in proper sequence. On August 1, 1917, the number of men engaged in the shipyards was in the neighborhood of fifty thousand, and that number, under the drive of our great necessity, was increased sevenfold in almost as many months. The men were brought to the shipyards by patriotic appeals, by the lure of high wages and by the probability of exemption from the draft. The problems connected with securing and building up this huge army of workers were numerous and complicated, and justified the creation of the Industrial Relations Division, with its various sections. The Division of Industrial Relations became charged not only with responsibility connected with the labor supply, its proper maintenance in health and safety, and the adjustment of minor differences and delinquencies; but it had to accept the burden of occupational draft deferments, the training and stimulation of workers, the proper allocation of the available labor supply, including the elimination of "scamping," and last, but by all odds the most difficult, the control of a proper adherence to the day rates, piece rates and classification of occupations established by the Shipbuilding Labor Adjustment Board.

But the establishment of a stable and effective labor force at each of the yards involved another problem of considerable magnitude. Unfortunately, the shipyards clustered about the fringes of the highly congested industrial centers of the seaboard and on the Great Lakes, and almost everywhere there were lacking adequate transportation facilities, adequate housing facilities, or both. Ninety-five million dollars were appropriated by Congress to relieve these conditions in the shipyards alone, and the Division of Passenger Transportation and Housing had to be developed in record time to assume charge of this highly important piece of emergency construction.

Securing an adequate supply of material in proper sequence, presented in essence just as many and as serious a set of difficulties as did the supply of labor. Beginning with the simple act of purchasing, the failure to make deliveries called very promptly for the organization of a production and expediting department, and the necessity of bringing the finished material to the completed hull presented a most interesting and difficult task in allocation, dispatching and transportation. It must be borne in mind that the Fleet Corporation accepted substantially full responsibility for supplying the raw materials, the finished materials, and the machinery for a wood ship program amounting to $450,000,000, and that, in addition, it was charged with the burden of securing all of the steel and a large part of the machinery for a steel ship program at least six times that size. Purchasing was but a minor part of a problem that involved responsibility for delay in supplying material of every character to every one of the 171 yards under contract with the Corporation.

It was considered best to concentrate in the hands of a single division the responsibility for buying, and delivering to the yards

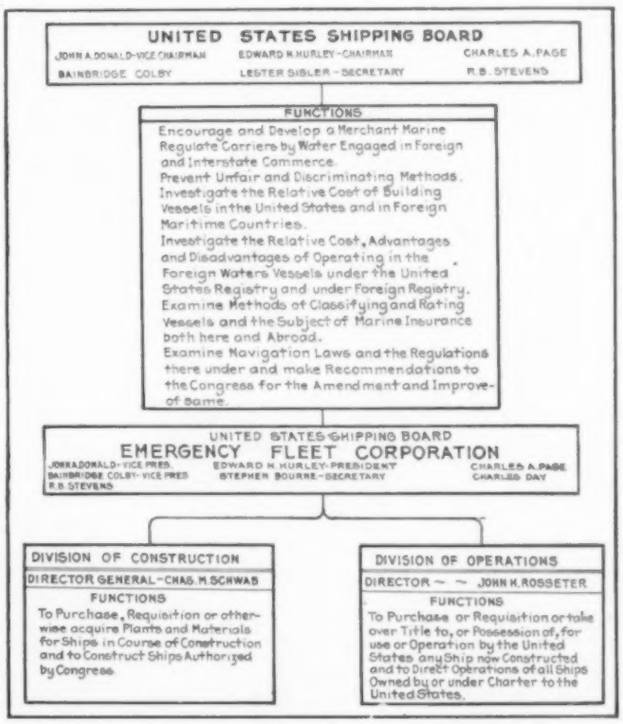
UNITED STATES SHIPPING BOARD
JOHN A. DONALD-VICE CHAIRMAN
EDWARD N. HURLEY-CHAIRMAN
CHARLES A. PAGE
BAINBRIDGE COLBY
LESTER SIBLER-SECRETARY
R.B. STEVENS
FUNCTIONS
Encourage and Develop a Merchant Marine
Regulate Carriers by Water Engaged in Foreign and Interstate Commerce.
Prevent Unfair and Discriminating Methods.
Investigate the Relative Cost of Building Vessels in the United States and in Foreign Maritime Countries.
Investigate the Relative Cost, Advantages and Disadvantages of Operating in the Foreign Waters Vessels under the United States Registry and under Foreign Registry.
Examine Methods of Classifying and Rating Vessels and the Subject of Marine Insurance both here and Abroad.
Examine Navigation Laws and the Regulations there under and make Recommendations to the Congress for the Amendment and Improvement of Same.
UNITED STATES SHIPPING BOARD
EMERGENCY FLEET CORPORATION
JOHN A. DONALD-VICE PRES.
BAINBRIDGE COLBY-VICE PRES.
R.B. STEVENS
EDWARD N. HURLEY-PRESIDENT
STEPHEN BOURNE-SECRETARY
CHARLES A. PAGE
CHARLES DAY
DIVISION OF CONSTRUCTION
DIRECTOR GENERAL-CHAS. M. SCHWAB
FUNCTIONS
To Purchase, Requisition or otherwise acquire Plants and Materials for Ships in Course of Construction and to Construct Ships Authorized by Congress.
DIVISION OF OPERATIONS
DIRECTOR — JOHN H. ROSSETER
FUNCTIONS
To Purchase or Requisition or take over Title to, or Possession of, for use or Operation by the United States any Ship now Constructed and to Direct Operations of all Ships Owned by or under Charter to the United States.

FIG. 1 RELATIONSHIP AND FUNCTIONS OF THE U. S. SHIPPING BOARD AND THE TWO DIVISIONS OF THE FLEET CORPORATION

on time and in proper sequence, all the material the Corporation was charged with furnishing, and the functions of purchasing, of tracing and expediting, of allocating and dispatching, of inspecting and of transporting, which in the earlier days of our development were performed by three different departments, were thereupon consolidated under the control of the Supply Division. This division built up effective district organizations in the various industrial centers of the country and maintained its contact with the shipyards through representatives in the offices of the District Managers in the shipbuilding districts.

There were then, in reality, two great supply divisions, one undertaking to provide the necessary labor and the other the necessary material, and these two divisions served the four divisions that were charged with the supervision of construction: The Division of Housing and Transportation, the Division of Shipyard Plants, the Division of Steel Ship Construction and the Division of Wood Ship Construction. Each of these divisions developed its own technical department, excepting that in the case of the two-ship construction divisions a single technical department covering both naval architecture and marine engineering, for both steel and wood ships, was created and placed under the administration of the Division of Steel Ship Construction.

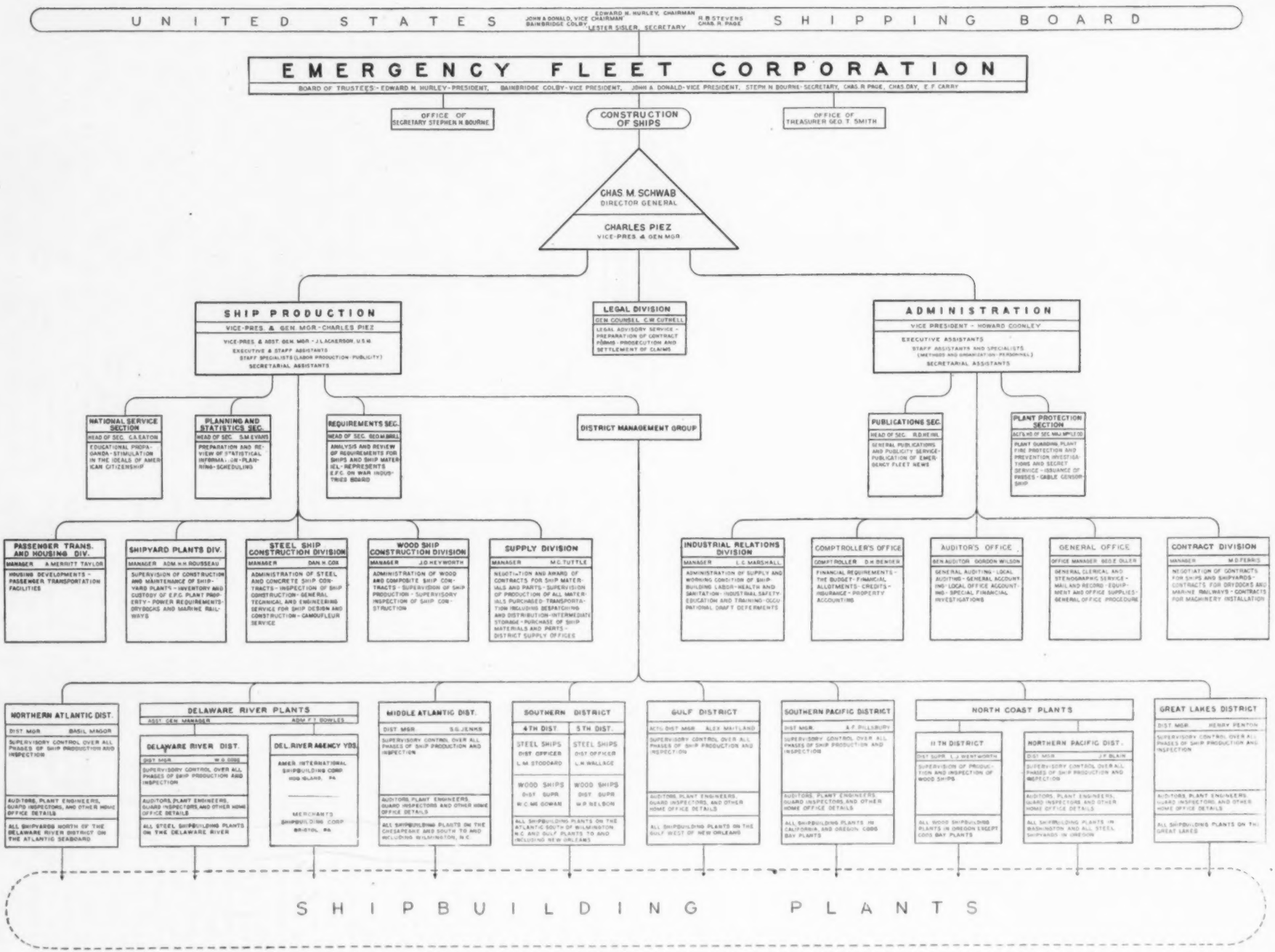
UNITED STATES SHIPPING BOARD
JOHN A DONALD, VICE CHAIRMAN
BAINBRIDGE COLBY
EDWARD N. HURLEY, CHAIRMAN
LESTER SISLER, SECRETARY
R.B.STEVENS
CHAS. R. PAGE
EMERGENCY FLEET CORPORATION
BOARD OF TRUSTEES - EDWARD N. HURLEY - PRESIDENT, BAINBRIDGE COLBY - VICE PRESIDENT, JOHN A. DONALD - VICE PRESIDENT, STEPH N. BOURNE - SECRETARY, CHAS. R. PAGE, CHAS. DAY, E. F. CARRY
OFFICE OF SECRETARY STEPHEN N. BOURNE
CONSTRUCTION OF SHIPS
OFFICE OF TREASURER GEO. T. SMITH
CHAS. M. SCHWAB
DIRECTOR GENERAL
CHARLES PIEZ
VICE-PRES. & GEN. MGR.
SHIP PRODUCTION
VICE-PRES. & GEN. MGR - CHARLES PIEZ
VICE-PRES. & ASST. GEN. MGR - J. L. ACKERSON, U.S.N.
EXECUTIVE & STAFF ASSISTANTS
STAFF SPECIALISTS (LABOR PRODUCTION - PUBLICITY)
SECRETARIAL ASSISTANTS
LEGAL DIVISION
GEN. COUNSEL C.W. CUTHELL
LEGAL ADVISORY SERVICE - PREPARATION OF CONTRACT FORMS - PROSECUTION AND SETTLEMENT OF CLAIMS
ADMINISTRATION
VICE PRESIDENT - HOWARD COONLEY
EXECUTIVE ASSISTANTS
STAFF ASSISTANTS AND SPECIALISTS (METHODS AND ORGANIZATION - PERSONNEL)
SECRETARIAL ASSISTANTS
NATIONAL SERVICE SECTION
HEAD OF SEC. C.A. SATON
EDUCATIONAL PROPAGANDA - STIMULATION IN THE IDEALS OF AMERICAN CITIZENSHIP
PLANNING AND STATISTICS SEC.
HEAD OF SEC. S.M. EVANS
PREPARATION AND REVIEW OF STATISTICAL INFORMATION - PLANNING - SCHEDULING
REQUIREMENTS SEC.
HEAD OF SEC. GEO. M. BRILL
ANALYSIS AND REVIEW OF REQUIREMENTS FOR SHIPS AND SHIP MATERIEL - REPRESENTS E.F.C. ON WAR INDUSTRIES BOARD
DISTRICT MANAGEMENT GROUP
PUBLICATIONS SEC.
HEAD OF SEC. R.D. HEINL
GENERAL PUBLICATIONS AND PUBLICITY SERVICE - PUBLICATION OF EMERGENCY FLEET NEWS
PLANT PROTECTION SECTION
ASST. HDS OF SEC. WALMSLEY
PLANT GUARDING, PLANT FIRE PROTECTION AND PREVENTION, INVESTIGATIONS AND SECRET SERVICE - ISSUANCE OF PASSES - CABLE CENSORSHIP
PASSENGER TRANS. AND HOUSING DIV.
MANAGER A. MERRITT TAYLOR
HOUSING DEVELOPMENTS - PASSENGER TRANSPORTATION FACILITIES
SHIPYARD PLANTS DIV.
MANAGER ADM. H.H. ROUSSEAU
SUPERVISION OF CONSTRUCTION AND MAINTENANCE OF SHIPYARD PLANTS - INVENTORY AND CUSTODY OF E.F.C. PLANT PROPERTY - POWER REQUIREMENTS - DRYDOCKS AND MARINE RAILWAYS
STEEL SHIP CONSTRUCTION DIVISION
MANAGER DAN H. COX
ADMINISTRATION OF STEEL AND CONCRETE SHIP CONTRACTS - INSPECTION OF SHIP CONSTRUCTION - GENERAL TECHNICAL AND ENGINEERING SERVICE FOR SHIP DESIGN AND CONSTRUCTION - CAMOUFLEUR SERVICE
WOOD SHIP CONSTRUCTION DIVISION
MANAGER J.O. HEYWORTH
ADMINISTRATION OF WOOD AND COMPOSITE SHIP CONTRACTS - SUPERVISION OF SHIP PRODUCTION - SUPERVISORY INSPECTION OF SHIP CONSTRUCTION
SUPPLY DIVISION
MANAGER M.C. TUTTLE
NEGOTIATION AND AWARD OF CONTRACTS FOR SHIP MATERIALS AND PARTS - SUPERVISION OF PRODUCTION OF ALL MATERIALS PURCHASED - TRANSPORTATION INCLUDING DESPATCHING AND DISTRIBUTION - INTERMEDIATE STORAGE - PURCHASE OF SHIP MATERIALS AND PARTS - DISTRICT SUPPLY OFFICES
INDUSTRIAL RELATIONS DIVISION
MANAGER I.C. MARSHALL
ADMINISTRATION OF SUPPLY AND WORKING CONDITION OF SHIPBUILDING LABOR - HEALTH AND SANITATION - INDUSTRIAL SAFETY - EDUCATION AND TRAINING - OCCUPATIONAL DRAFT DEFERMENTS
COMPTROLLER'S OFFICE
COMPTROLLER D.H. BENDER
FINANCIAL REQUIREMENTS - THE BUDGET - FINANCIAL ALLOTMENTS - CREDITS - INSURANCE - PROPERTY ACCOUNTING
AUDITOR'S OFFICE
GEN. AUDITOR GORDON WILSON
GENERAL AUDITING - LOCAL AUDITING - GENERAL ACCOUNTING - LOCAL OFFICE ACCOUNTING - SPECIAL FINANCIAL INVESTIGATIONS
GENERAL OFFICE
OFFICE MANAGER BODE OLLER
GENERAL CLERICAL AND STENOGRAPHIC SERVICE - MAIL AND RECORD - EQUIPMENT AND OFFICE SUPPLIES - GENERAL OFFICE PROCEDURE
CONTRACT DIVISION
MANAGER M.D. FERRIS
NEGOTIATION OF CONTRACTS FOR SHIPS AND SHIPYARDS - CONTRACTS FOR DRYDOCKS AND MARINE RAILWAYS - CONTRACTS FOR MACHINERY INSTALLATION
NORTHERN ATLANTIC DIST.
DIST MGR BASIL MAGOR
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTIONS AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS, AND OTHER HOME OFFICE DETAILS
ALL SHIPYARDS NORTH OF THE DELAWARE RIVER DISTRICT ON THE ATLANTIC SEABOARD
DELAWARE RIVER PLANTS
ASST. GEN. MANAGER ADM. F.T. BOWLES
DELAWARE RIVER DIST.
DIST MGR W.O. GOSS
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTION AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS, AND OTHER HOME OFFICE DETAILS
ALL STEEL SHIPBUILDING PLANTS ON THE DELAWARE RIVER
DEL. RIVER AGENCY YDS.
AMER. INTERNATIONAL SHIPBUILDING CORP. HOG ISLAND, PA.
MERCHANTS SHIPBUILDING CORP. BRISTOL, PA.
MIDDLE ATLANTIC DIST.
DIST MGR S.G. JENKS
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTION AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS AND OTHER HOME OFFICE DETAILS
ALL SHIPBUILDING PLANTS ON THE CHESAPEAKE AND SOUTH TO AND INCLUDING WILMINGTON, N.C.
SOUTHERN DISTRICT
4TH DIST. 5TH DIST.
STEEL SHIPS DIST. OFFICER L.M. STODDARD
STEEL SHIPS DIST. OFFICER L.M. WALLACE
WOOD SHIPS DIST. SUPR. W.C. McGOWAN
WOOD SHIPS DIST. SUPR. W.D. NELSON
ALL SHIPBUILDING PLANTS ON THE ATLANTIC SOUTH OF WILMINGTON N.C. AND GULF PLANTS TO AND INCLUDING NEW ORLEANS
GULF DISTRICT
ACTG DIST MGR ALEX MAITLAND
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTION AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS, AND OTHER HOME OFFICE DETAILS
ALL SHIPBUILDING PLANTS ON THE GULF WEST OF NEW ORLEANS
SOUTHERN PACIFIC DISTRICT
DIST MGR A.F. PILLSBURY
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTION AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS, AND OTHER HOME OFFICE DETAILS
ALL SHIPBUILDING PLANTS IN CALIFORNIA, AND OREGON, COOS BAY PLANTS
NORTH COAST PLANTS
11TH DISTRICT
DIST SUPR. L.J. WENTWORTH
SUPERVISION OF PRODUCTION AND INSPECTION OF WOOD SHIPS
ALL WOOD SHIPBUILDING PLANTS IN OREGON EXCEPT COOS BAY PLANTS
NORTHERN PACIFIC DIST.
DIST MGR J.F. BLAIN
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTION AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS AND OTHER HOME OFFICE DETAILS
ALL SHIPBUILDING PLANTS IN WASHINGTON AND ALL STEEL SHIPYARDS IN OREGON
GREAT LAKES DISTRICT
DIST MGR HENRY PENTON
SUPERVISORY CONTROL OVER ALL PHASES OF SHIP PRODUCTION AND INSPECTION
AUDITORS, PLANT ENGINEERS, GUARD INSPECTORS AND OTHER HOME OFFICE DETAILS
ALL SHIPBUILDING PLANTS ON THE GREAT LAKES
SHIPBUILDING PLANTS

FIG. 2 CHART SHOWING ORGANIZATION OF THE EMERGENCY FLEET CORPORATION

For the purpose of controlling the actual construction in the field, the country was originally divided into eleven districts, in each of which there was one or more representatives of each of the construction and service divisions and sections. Later the control of all of the functions in each district was placed in the hands of a district manager who, as the direct representative of the Vice-President and General Manager, exercised in respect of the districts all of the authority which the latter exercised over the operations of the Corporation as a whole. The number of the districts was also reduced from eleven to eight.

This step of decentralization aided materially in the expedition and dispatch of affairs, particularly as the lines of direct communication between the sub-heads of the district and the corresponding division heads at the Home Office were preserved.

The various divisions and sections at the Home Office communicate directly with their appointed representatives, but send carbon copies of all directions and instructions to the District Manager, who is given the power to veto any instructions and stop any processes which, in his judgment, and from his local viewpoint and his first-hand contact with the problems affected, are inimical to the interests of the Fleet Corporation. Failing to convince the division or section at the Home Office of the soundness of his decision, appeal lies to the Vice-President and General Manager.

Time is a most essential factor in the development of any organization, and this is particularly true of those huge organizations that grew out of the necessities of the war. It took time to see and grasp the real needs; time to develop the scheme of the organization; time to pick and test the men to manage affairs; time to develop the proper team spirit, the spirit of discipline and submission to the central controlling authority.

Every division of the Fleet Corporation presented problems exceeding in number and magnitude the problems presented by an industrial or commercial enterprise doing a business of many millions a year, and every division required an organization of which the organization of the Corporation was but the pattern. The real difficulty lay not in choosing the general form of the organization as presented by the chart, Fig. 2, but in finding men who had not only the necessary experience and capacity for the job, but the proper temperament to blend quickly and harmoniously with the rest for the smooth and effective accomplishment of the task. Since the selection of the men presented the chief difficulty, we had no hesitancy in building our organization around the mental capacities and the temperamental peculiarities of the men we had available. The chart presented in Fig. 2 should not therefore be studied with the idea that it represents the last word in theoretical relationship and perfection. I have never been impressed with the value of a system chart unless I knew the men whose functions it depicted, for a chart without the personnel is like an equation with none but unknown quantities. The organization of the Fleet Corporation has been in a state of flux from the very first, and intentionally so, because it gave an opportunity for those quick changes and rearrangements which emergency conditions constantly demand. Today, with the pressure over, some of the functions will disappear, others will be consolidated and a new management adjusted to normal conditions will result.

The organization through the past six months of its career has been subjected to the constant critical study of an organization and methods section, attached to the staff of the vice-president in charge of administration, and this section has suggested administrative changes, has assisted in the definition of duties and responsibilities of the operating units, and has pointed out duplications of work and inconsistencies and overlaps in jurisdiction. It has made a study of the duties and responsibilities of different positions, and has developed a plan for bringing about uniformity in classification and salaries of employees, which is now in operation. Instructions given by the general officers of the Corporation are issued in the form of orders, which may be either general, special or technical; and these for the purpose of securing consistency and harmony with orders of a similar character previously issued are cleared through the Organization and Methods Section. The necessity of such a constant critical study of an organization which extraordinary pressure is expanding with great speed is apparent, and its value in reducing such a hastily gathered organization to a well-balanced effective unit is open to no doubt.

Coming now to a more detailed description of the organization as it existed before the signing of the armistice, complete power was delegated by the Board of Trustees to the Director General, who retained control of the policy of the Corporation, but placed control of the management in the hands of the Vice-President and General Manager. As an immediate relief to this official, the general duties and activities were divided into two main groups, one covering ship production, administered by the Vice-President and General Manager, with a Vice-President and Assistant General Manager in more immediate charge, and the other covering Administration, with a Vice-President in charge. The various sections and divisions, with their relationship and lines of authority, are so clearly indicated by the chart as to require no further comment, except that the position of the Industrial Relations Division, under the Administration group of activities, is due to a desire to more nearly balance the work of the two groups. The Industrial Relations Division serves the Production Divisions, but the relationship between the Vice-Presidents is so close and harmonious that the rather strained position of this division has resulted in neither embarrassment nor friction.

The Corporation is charged with responsibilities that involve a total expenditure of $3,880,000,000, and the construction of a fleet of vessels which, with certain emergency exceptions, will be so varied and well-balanced as to meet the requirements of our commerce with our own territories and possessions, and with foreign countries as well. The activities of the Corporation will result in an American Merchant Marine of 15,000,000 dead-weight tons, and the members of the organization who have spent many months under the high pressure of national needs look to that result for their compensation.

STANDARDIZATION AND ADMINISTRATION OF WAGES

By H. P. KENDALL,[1] NORWOOD, MASS., AND F. D. HOWARD,[2] WASHINGTON, D. C.

WHEN the United States entered the war there was very little administrative machinery for dealing with industrial relations. These relations were affected in some slight degree by legislation touching hours of work for women, workmen's compensation acts, and other laws for the protection of workers. There was also the Department of Labor, which had very little or no authority to regulate industrial relations, but whose function was confined to publication of information and mediation of difficulties when called upon by both parties. Industrial relations were adjusted by the free competition between the employer and employee. The terms of the contract were determined by competitive industrial conditions, the relative demand and supply of labor, and the extent to which workers were organized for collective bargaining. These contractual industrial relations were largely determined by the relative bargaining strength of two parties and varied as the conditions of economic strength varied.

The system of contractual relations was in many cases modified by the benevolence or feelings of conscientious responsibility on the part of the employer on one side and by the feelings of loyalty and of ignorance of business principles on the part of the employees. These modifications were more likely to be present when the personal relations between employer and employee in small establishments were close enough to make personal relationship possible. In the larger establishments, where there could be no personal acquaintance and contact, the relationship was of necessity less influenced by other than economic considerations. Very general attempts had been made to evade this difficulty by the establishment of service departments in larger businesses, but this institutionalized benevolence outside the contract of employ-

[1] Treasurer, The Plimpton Press. Mem.Am.Soc.M.E.
[2] Executive Secretary, Committee on Industrial Relations.

ment was not always successful in eliminating the conflict of interests involved in the system of contractual relations.

The adjustment of relations by contract, especially during war times, involves difficulties too dangerous and wasteful to be tolerated. When there are swift and sudden changes in the relative supply and demand for labor the natural economic tendencies toward a new equilibrium of wages create unsettlement and unrest. It is a fundamental principle that there can be no free contract unless either party is at liberty to withhold a commodity or service for which he is bargaining. The withholding of the service of labor involves, unfortunately, the cessation of industry and is attended by waste and harm to parties not directly involved in the negotiations. Much of what is called industrial unrest is merely the natural manifestations of the bargaining process which is the fundamental part of the system.

Because the contractual relations are determined by the relative economic strength of the parties and because economic strength is created by organization, it is inevitable that the contracting parties should organize in order to secure an advantageous position by collective action for bargaining. The weakness of collective bargaining lies in the fact that it involves creating force, which may easily be abused or used for evil ends by unscrupulous men who are able to possess it.

War Labor Policies Board

The so-called labor problem was unquestionably the greatest political and economic problem of the American people prior to the war. The changes in production by machinery and the need for greater production with the coming of the war accentuated this problem and the extravagant and disproportionate wage increases have added to the unrest. The winning of the war depended on a new method of securing industrial peace so necessary to secure the required production. The War Labor Policies Board was created for that purpose, to work out a national policy and correlate the activities of the various wage-adjustment boards which were emergency instruments. The War Labor Policies Board made use of determined standards and adjudicated decisions which had met with the greatest success in both private industrial plants and in industries at large. Learning also from the British experience, it first set out to establish in one industry after the other, beginning with the most important ones from the war viewpoint, wage-adjustment boards more or less supervised by the Government agencies.

With the approach of peace, the winning of the war is no longer the supreme Government purpose, and with the close of hostilities the problem of industrial relations and industrial peace is relatively not less important, but more. It is by far the greatest problem that we face. The employing and the employed now have the opportunity to develop constructively a plan and policy for setting up standards and settling labor differences without the use of force. If industrial managers lead in this there will be no occasion for governmental interference or control. It is for us to determine the establishment of broad basic principles governing the standards and administration of wages. Such a subject, however, is far broader than mere wages. It means the entire field of industrial relations, of which wages is an important part, not the whole factor.

In order that the productive energies of the nation might not be dissipated in wasteful labor controversies, it became the first duty of the Government to provide activities to secure industrial peace. A sudden change in the condition of supply and demand brought into play tendencies to unsettle the accustomed status of wages, hours and conditions of work. This was accentuated by the same tendencies operating to change prices of commodities as manifested in the increased cost of living.

The time was too short to deal with the problem fundamentally. For the settlement of controversies the Government organized the War Labor Board, properly known as the Taft-Walsh Board, whose function it was to adjudicate disputes. In order to secure some measure of consistency in their decisions, the Board recommended a set of principles which was prescribed by its president. The principal points were the recognition of the right of the worker to organize to bargain collectively without fear of the customary measures of employers to prevent this, the living wage and the 8-hour day.

In addition, a coördinating agency was established, known as the War Labor Policy Board, composed of representatives of the purchasing departments of the Government. The functions of this board were to create uniform standards in industrial relations and uniform policies for their administration.

Post-War Labor Problems

With the end of the war, the greatest industrial problem doubtless is this: What general principles shall be followed in dealing with the labor problems of the future with all their unseen dangers and possibilities? War has changed conditions to such an extent that a return to the *status quo ante* is difficult, even though it were desirable and possible. The only alternative to the old system of allowing industrial relations to be adjusted by natural economic laws and preventing bargains seems to be that of standardization, or the conscientious and systematic regulation of these relationships by collective action, which does not necessarily mean Government administration, but which may be accomplished by voluntary collective action.

The term "standardization" does not necessarily mean uniformity of wages, hours or conditions of work. It means the determination of these conditions according to general principles, the justice of which is universally acknowledged. It is much easier to establish general principles than it is to derive the particular standards and apply them to actual situations.

The regulation of industrial standards by joint boards as suggested has the great advantage over the present system in that it eliminates at least three-fourths of the cost of friction and strife between the particular employer and his employees. Each employer then adopts the standards which are current in his trade and knows that all his competitors are on the same basis and have no advantage over him. Even under our present system, the chief objection to any one employer's increasing wages lies in the fact that it comes out of the profits unless the increase is general among his competitors, when it is shifted to the consumer of the product. It is easy to foresee a time when the public and not the employers will have the chief interest in opposing wage advances.

In many, if not most, of the cases where employment conditions are admittedly unsatisfactory, the employers are helpless to improve them on account of the pressure of competition. The plan for organizing adjustment boards provides a remedy for this by attempting to establish standards for itself which are protected against demoralization by competition.

The tendencies for industries to become more and more dependent upon each other is increasing and the consequence of this is an increasing necessity for industrial peace. The indirect effects of stoppages increase with the greater integration of industry, and the number of interests and people who suffer from labor difficulty and yet have no direct participation in them grows each year. A street-railway strike, for example, in a great city causes a collateral loss of business all out of proportion to the amount in dispute between the company and its employees. The indirect interests affected by labor disputes are therefore becoming so important as to be entitled to more consideration than formerly.

The administration of industrial relations, especially wages, by a skilled person specialized for the work is no longer an experiment. No industrial administration is complete until in some part it is sensitive or responsive to the aspirations and grievances of the employee. The efficiency of production is often affected fundamentally by action taken in other departments of the business. Moreover, the labor manager has an opportunity to interpret a business policy to be established by the working force and may frequently forestall opposition and ill-feeling by timely explanation of the reasons for such policies and standards.

There is a tendency where standards are fixed by haphazard methods or in the heat of struggle with labor unions for certain fundamentally right and efficient principles to be overlooked or

submerged. That wherever there is a standardized wage there should also be a specified measure of proficient labor performed is not to be disputed by any reasonable person; yet situations are created where this just principle is opposed by labor organizations who feel compelled to take that position because of the circumstances of the situation. Another principle, equally self-evident, is that every worker has a moral right to compensation in direct proportion to his individual accomplishment, yet for reasons which seem to them to be valid, the unions frequently set themselves squarely against piece-work or bonus systems which aim to employ this principle. Under some system of standardization it is likely that these just principles may be reëstablished with proper safeguards against abuse.

Labor to Coöperate

The war period has created a very perceptible change in attitude on the part of employers toward what is loosely termed "collective bargaining." This means that employers recognize the need for a greater sense of responsibility on the part of the employees toward the efficiency and success of the business in which they are engaged, and that in order to develop this sense of responsibility greater participation shall be granted to the workers. Moreover, the worker should be given an opportunity to learn more about the policies of the establishment and the difficulties of management. It is recognized that the indifference and even hostility of the workers to efficiency arises from their relationship to the business and the absence of reasons why they should be interested.

The Federal Labor Administration, following the President's proclamation by which the War Labor Board was created and manifested in the collective-bargaining clauses of the Quartermaster's and Ordnance contracts, gave an impetus to the general principle of participation in management which many have begun to see offers an opportunity for a general betterment of industrial relations in individual plants. The introduction of a system of organized representation of employees by the Standard Oil interests and the apparent success of the idea has stimulated general interest, and it now appears that this idea is likely to be much more generally accepted, especially by large industrial plants. That responsibility creates conservatism is a truth which has been demonstrated, and nowhere more convincingly than in industrial relations. Give employees responsibility and opportunity to exercise it, and sooner or later there must develop leadership among them which will contribute not a little to the vitality and general efficiency of the establishment.

To make this plan truly successful, however, the management must decide to give labor a fair share of the results of the efficiencies and economies realized. Too often by the introduction of new methods and labor-saving machinery the employer cannot bring himself to yield a share of the benefits to the employees, although he expects them to bear uncomplainingly the hardships which may attend the transition. The difficulties of systematically giving to the workers their share of the profits are perplexing. The subject of profit sharing is very attractive, but the difficulties have frightened many away from the subject. Any system of profit sharing should take into full account the permanent needs of the worker and attempt to satisfy them to a maximum. It is difficult to know what is the right and just method to use, but the difficulty will be largely overcome in individual establishments by the proposed plan of standardization or regulation of industrial relations.

INTENSIVE TRAINING

By C. R. DOOLEY,[1] WASHINGTON, D. C.

THE run of the draft only partially supplies the number of trade specialists needed by the army. At the Field Artillery Replacement Depot, Camp Taylor, the Personnel Officer is able to get just one-half the required specialists from the draft, and he looks to the Committee on Education and Special Training for the balance.

[1] Educational Director, Vocational Instruction, Committee on Education and Special Training, War Department.

The records at the camps show that less than ten per cent of the men have had a high-school education or better and that the great majority have had no special training of high degree, and lack skill or even any continuity of experience.

The Committee on Education and Special Training was appointed in February 1918 with instructions to train men for the service. First of all the men must be soldiers, disciplined to prompt and complete obedience and broken into the routine of army life; second, they must be skilled in those trade specialties needed in the army; third, they must have that originality and initiative which will enable them as soldiers to use the tools and materials at hand in meeting emergencies.

The Committee adopted a program about as follows:

1 Military training
2 Sorting and training according to ability
3 Trade fundamentals and combinations
4 Development of originality and initiative.

Two months were allowed as the length of each course and six months, April 15 to November 15, were assigned to the experiment. A total of 90,000 men were to be trained.

Administration, Organization

The Committee and executive military officers remained in Washington in charge of the planning. The United States was divided into ten districts with field military officers and district vocational directors in full charge of administrative details. They literally went from coast to coast inspecting, approving and establishing units, wiring in the results each night from April to August.

A large production chart showed the capacity necessary to be arranged for each day in order to meet the 90,000 by November 15. The great majority of school heads were willing and eager to tackle the new job. No greater evidence of American resourcefulness has been developed than that of the 140 odd schools in their radical changes of equipment, methods and policies to meet this emergency. We all agreed it could not be done, but had to be, and that was sufficient. The production chart was eagerly watched day by day until the danger line was passed, and now we are closing up the experimental period with a total of approximately 100,000 men trained in some thirty different trades.

Methods Employed

Military Training. Three hours a day were devoted to Infantry Drill, Military Courtesy, Inspection, and General Military Training, tending not only to break in green men but to develop habits of promptness, precision, order, and to establish a company spirit in place of the normal American individual spirit.

Sorting and Training According to Ability. Both the experience and the natural aptitude of each man were used as a foundation to build upon. Where these coincide the job of training is easy. Where they are opposed the best of judgment and tact must be used to determine the right classification and assignment. If a man has made a success at a given line of work the chances are favorable for giving him further special training in the same lines. On the other hand, circumstances of youth have often prevented men from following their natural talents. Such cases are by no means the exception.

For example, the Dickinson High School of Jersey City positively had the least desirable detachment of men sent by the various draft boards to any school in the second district, and I am inclined to believe to any school in the country. Over 60 per cent came from the lower east side of New York: sweat-shop workers, garment workers, toughs, men from the docks, teamsters and every kind except men from the mechanical trades; men who had never been in an industrial shop; never handled a shop tool and who seemed hopeless for training.

They were assigned to classes and our job was started. In a few days there was a remarkable change. An able commanding officer and his lieutenants took them in hand. Due to this admirable military discipline and the efficient shop instruction some

360 "fighting mechanics" were delivered to the army. Another group of laborers who had never done any forging were converted into capable blacksmiths within six weeks. In another case a young man who came directly from the farm was given instruction in sheet-metal work. In six weeks' time he was making stovepipe elbows of commercial quality from patterns which he himself developed by sound principles of descriptive geometry. In this particular school the instruction was given right in the machine shop in connection with the making of the pieces and the principles of projection and intersection were learned in a manner which made them a part of this young man's consciousness rather than by merely memorizing methods.

One of the inspiring things about these and hundreds of other incidences is the fact that the men themselves are enthusiastic about continuing with some form of industrial work even after the war. Three men in patternmaking at Carnegie Institute of Technology had formerly been bank clerks and declared most emphatically that they would never leave the woodworking industry.

The creative instinct seems to be fundamental in human nature and the accomplishment of practical results without help is the most stimulating of human experiences. With this motive established, a man normally becomes hungry for more accurate and deeper scientific information in order that his creation may be more perfect and he therefore begins to teach himself and the instructor merely becomes the means for the final checking of results.

That fundamental principles are infinitely more important than even a very great assortment of specific formulæ and rules is no longer doubted, yet this has been demonstrated again and again in the army training schools so that it will bear repetition here. For example, at one of the camps a group of soldiers built and installed a complete multiple-jack switchboard for telephone service out of nothing in the world but scrap. This could not possibly have been done without a thorough understanding of the simple principles of electricity and magnetism.

Many of the jobs in the army do not completely follow the standard lines of industrial occupation, and it was therefore necessary to define the duties of the men in terms of the work to be done, which many times included certain very definite combinations of parts of standard trades. For example, the operator of a mobile machine shop for the Ordnance Department must be able to operate a small lathe, a small drill press and do small vise and bench work. Further, he must be able to do gas welding, especially on thin metal parts, and must maintain in operating condition a gas-driven electric generator and several electric motors. Such an operator is called a machinist, although obviously a machinist as ordinarily known has no knowledge of gas welding or small motor operation, and could not fill the bill.

This emphasizes the great value of the man who can handle several different trades. Obviously he cannot become thoroughly skilled in all the phases of a number of trades, but by limiting the instruction to the fundamentals several allied trades may be covered, adding greatly to a man's usefulness.

Among other things that have been shown by the war to be advantageous is that type of efficiency which reckons on the personal originality of each man rather than on the completeness of the detail of his instructions, of a type of training that is flexible and elastic rather than rigid and exact in all predetermination. The war has been won through inspiring leadership that somehow seemed to spring from the atmosphere rather than through autocratic force. And so with the soldier-mechanic, much faith is placed in his ability to meet successfully new situations if only we can give him a correct understanding of the simple fundamentals of his trade and stimulate his constructive imagination.

The war is over. Thousands of men will return to industry with keen, alert minds, disciplined to act promptly and thoroughly as members of a team rather than as individuals. Many will not be highly skilled in civil occupations and will have to be trained in special work, but they will learn quickly and will advance rapidly because of their military experience.

The Committee on Education and Special Training could operate its organization backwards, so to speak, and train the returned soldiers for industrial work during the process of demobilization if such a plan were approved.

Industrial training means vocational skill, plus imagination and initiative, plus the discipline of keen service which marks the beginning of true leadership. It is hoped that the work of the Committee has contributed to the cause of general education in establishing some evidence of the fact that military training and vocational or academic training supplement each other; and in holding up before all students the motive of production for the community rather than for individual profit.

FIRST GENERAL SESSION

Discussion of Mr. Halsey's Paper on the Extent to Which the Metric System is Used in Latin America, and also Mr. Gantt's Paper Establishing a Relation Between Efficiency and Democracy

AT THE General Session, held on Thursday afternoon, Vice-President-elect John A. Stevens officiated as chairman. Two papers were presented, as follows:

THE WEIGHTS AND MEASURES OF LATIN AMERICA, Frederick A. Halsey

EFFICIENCY AND DEMOCRACY, H. L. Gantt.

Mr. Halsey's paper represents a thorough investigation to find out, from replies to about 500 questionnaires sent by disinterested American firms to prominent firms and individuals in the twenty-odd Latin-American countries, the system of weights and measures actually used in retail buying and selling, in the clothing trade, land measures, industries, farm products, rail and ship transportation. The replies furnish proof for his statements that nowhere is the metric system used exclusively, and that in countries that have adopted the metric system, the English system is also used, together with the original Spanish units, which, it is shown, differ but little from the corresponding Anglo-Saxon units. The author is of the opinion that the metric system has been pushed to the front chiefly by German influence, and as this has now been eliminated largely, it might be opportune at this time to unify the weights and measures of North and South America and the British Empire.

The aim of the author is to disprove: 1, The theory that it is an easy and simple matter for a country to change its system of weights and measures; 2, that the adoption of the metric system does away with confusion; 3, that this system is in universal use except in the United States, the British Empire and Russia; 4, that we must adopt the metric system if we desire to do business with Spanish America; 5, that the "adoption" of this system saves time in schools; 6, that it saves time in calculations, when in reality more conversions are made necessary by it; 7, that the persistence of old units in metric units is a persistence of names but not of things, which is not so; 8, that we will use the exact metric equivalents for English sizes. Reviewing the many unsuccessful attempts made elsewhere to install the metric system, the author is convinced that if it were to be adopted here in the United States it would only lead to needless confusion.

DISCUSSION OF MR. HALSEY'S PAPER

The paper evoked a very lively discussion, both sides being emphatic in the expression of their opinions. As usual with this

topic there were two groups; Mr. Halsey and his supporters looked at the question from the viewpoint of the manufacturer and the machine shop, while the opposite group was influenced by the theoretical or scientific advantages that it was believed would be brought about by a change to the metric system.

James Hartness, who opened the discussion, said that while he wished to be looked upon as a pro-inch man, and felt that the industrial worker preferred to adhere to this old-established system, he had a high regard for the scientist who is naturally in favor of the decimal and metric system. Realizing, as a result of the war, the need of close coöperation between all factions, and recognizing the fact that ultimately one system of weights and measures must prevail in international dealings, and in view of the present preponderance of Anglo-Saxon influence, he thought that one way out of the difficulty was to make the meter equal to 40 inches, as had been proposed in the past.

Howard Richards, Jr., Secretary of the American Metric Association, New York, emphasized the great simplicity of the metric system of measures, in which 1000 cubic centimeters or 1 cubic decimeter equals 1 liter or 1 kilogram of water. As is well known, in the metric system the meter for measuring length, the cubic decimeter or liter for measuring capacity, and the cubic centimeter of water or gram, are the related and fundamental units. He thought the utter simplicity of these units should commend the system to all who were favorably inclined to efficiency. He exhibited a 12-page pamphlet, issued by the American Metric Association, setting forth in detail the advantages of the metric system of measures. He challenged any one present to give him offhand the length of the side of an acre square, and elicited three replies, all differing and none exact.

Mr. Richards quoted Edwin M. Herr, formerly a vice-president of the Society and now president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, as having told him, a few days before, that the Westinghouse Co. could make the change to the metric system by coöperating with the other engineers.

Henry D. Sharpe considered the work of Mr. Halsey as very valuable in that it disproved the claim made that there was urgent need of adopting the metric system to hold foreign trade.

Ralph E. Flanders was in perfect accord with what Mr. Hartness had said on the value of reconciling the needs of the shop man and the desire of the scientific engineer. He therefore offered the following motion, which was seconded by Mr. Hartness:

RESOLVED: That it is the sense of this meeting that the possibilities of the changing of the meter to forty (40) inches be brought to the attention of the Council of this Society, and that the Council be asked to consider such action as may lead to the adoption of this change by the metric countries.

Luther D. Burlingame said he had for years been interested in the subject of measures, and was chairman of the Society's Committee on Weights and Measures. It was a revelation to him to learn from Mr. Halsey's paper the extent to which the English system was used in Latin America, and to see how closely the important units of the old Spanish system agreed with it. He therefore found himself at variance with Dr. Samuel W. Stratton, chief of the Bureau of Standards, who had contended that the metric system was the most popular one in those countries. That the English system was acceptable to the twenty Latin-American countries was, according to Mr. Burlingame, proved by the fact that the total trade between the United States and those countries during the fiscal year 1917-1918 exceeded that of the year 1913-1914 by $1,000,000,000. He quoted Henry D. Sharpe, Treas., Brown & Sharpe Mfg. Co., as having said on this subject:

Instead of a change to the metric system being a benefit to our foreign trade, it would mean confusion to our home manufacture and use, placing a burden on us which would be a serious handicap in our competition for world markets.

Referring to Mr. Flanders' motion, Mr. Burlingame indicated that certain constructive steps had just been taken by the Society's Council, and that this was one of the matters that had led President Main to depart for Europe. Pending such negotiations, he would advise not to urge the motion before the house, because Great Britain was likely to take the initiative in the matter of unifying all measures, and we could afford to postpone definite action.

Mr. Burlingame thought that the paper was timely, and indicated a possibility for securing the adoption of the Anglo-Saxon system in Latin America, for which purpose he hoped a commission would be appointed to confer with representatives of those countries.

Adolph L. De Leeuw spoke rather in favor of the English system, and thought a 40-in. meter would greatly add to the confusion. He felt that the question of change of system had not been considered with an open mind. He said we should ask ourselves three questions: 1. If we had to choose a new system, would we select the metric or the English? 2. How much would it cost to change to the metric system? 3. Would the benefits be commensurate with the cost of changing? He would like to see fair play, and have the question definitely settled, whether or not the metric system was superior to the English. He said he knew from experience that it was a task to change metric dimensions or drawings to English dimensions, but that the change from English to metric would be no less awkward.

Samuel S. Dale, editor of *Textiles*, Boston, gave a lengthy discussion in favor of making the English system the universal standard. He showed that the present Spanish tables give the same multiples as the English, while the units themselves vary only 1.4 per cent from our units. He stated that in Russia the linear measures are based on the English inch and foot. The Chinese foot is equal to 12.6 English inches, but is divided decimally. The Japanese foot is 11.93 English inches. Even before the war, 70 per cent of the world's industrial energy was based on English weights and measures, and the situation at the end of the war precluded the adoption of any but the English system as a world standard. He called attention to the fact that British committees in reporting to Parliament regarding British policy after the war, did not recommend the compulsory adoption of the metric system, but held that a universal system would have to be acceptable to the British Empire and to the United States, and that in the meantime a simplification of the British system should be effected.

Mr. Dale said further that the object of such an inquiry was to remove the defects and equalities in the English system, which were but a mote compared to the mass of radical defects in the metric system, which we were asked to adopt. He welcomed the investigation suggested as tending to counteract what he called "pro-metric propaganda" by various Government Bureaus at Washington. He stated that Senator Shafroth of Colorado had introduced a bill during the preceding month (S. 5037) providing that the use of the metric system shall be compulsory in the Government departments, except in the survey of lands, after January 1, 1920, and that it shall be the standard of the country after January 1, 1922. He hoped the people would have a voice in settling this great question of change of system, because it should not be left to the "irresponsible theorists in the bureaus at Washington." He considered that the American Institute of Weights and Measures was best fitted to improve our English system and to oppose compulsory metric legislation.

Henry M. Hobart said he believed that a 40-in. meter would be equally unpopular with all parties concerned. Also that few realized to what a great extent the metric system was already established in the world. He was convinced that while working with the metric system in Germany his efficiency was higher than when he used the English system in Great Britain and the United States. He said it was not true that the British system was used to any considerable extent in Germany, but that the metric system was in use almost universally, as an inspection of textbooks would show. He thought this was the reason why Germany could produce so much more efficiently and cheaper than could the English-speaking countries.

Instead of adopting the 40-in. meter, he thought it would be simpler to await the death of the present generation, and regretted that in the intervening twenty years America and Great Britain must be allowed to fall behind in the matter of decimal systems

until younger men, imbued with more noble emotions, came to the front and caused the metric system to be adopted in this country.

Charles W. Johnson prefaced his remarks by stating that his viewpoint was that of a machine-shop man. He reasoned that if it was true that it took a year longer to educate a child in the English system than it did in the metric, that was an advantage, because it made him think, something he was supposed to learn how to do. Hence, the English system should be retained, for it is so complicated that it would make the child think!

Mr. Johnson wished to go on record as being decidedly opposed to the exclusive use of the metric system, for the sake of the operating men in industry. He said he had as yet discovered no advocate of a complete adoption of the metric system among industries manufacturing large varieties of complicated products where repair parts must be supplied. He thought the cost of retracing 500,000 drawings, converting inches into millimeters, would be prohibitive, and would bring no corresponding advantages. The method preferred now is to use even figures or simple fractions, because they are easier to work to than extended decimals. To employ metric units on new work only, he also thought to be impractical because of the mixed system of machine tools which would be necessary; besides, there were many old standardized pieces incorporated in new designs, so that the result would be great confusion. He referred to an article in the September 1916 number of *Machinery*, entitled The Metric Agitation, as being a clear and honest exposition of the conditions as affecting the machine shop.

Mr. Johnson added that if Latin-American business men preferred shipping papers to give weights and dimensions of packages in metric units, there was no objection to that, and that metric outline and foundation plans could be readily supplied, but he could not see why the parts themselves should be fabricated according to the metric system. He said it was most inopportune to make such a change now, because in the years following the war, with taxes high and labor conditions disturbed, it would be necessary to practice economy and efficiency more than ever. To be better able to meet competition, he thought we could not afford to expend millions of dollars in trying to introduce a system the benefits of which were apparent only to men of academic minds.

Charles E. Skinner said he represented the same company as Mr. Johnson. He was in favor of having but one international system, it did not matter which; but as to adopting the metric system, he was opposed for the same reasons Mr. Johnson had given, because he said the vice-president of the Westinghouse Elec. Mfg. Co. had estimated the initial cost of retracing their million drawings would be at least $1,000,000, with no compensating advantage; and, as he would be burdened with the task, he preferred to see things left as they are. Furthermore, the English-speaking peoples now occupied the dominating place in the world, and he thought they could retain it better by adhering to their present system.

D. E. Lauderburn said he had been practicing forest engineering since 1907, and had cruised timber in both the republics of Cuba and Santo Domingo. He found that the fundamental standards in these countries were metric, that the governments were using metric weights and measures, and that the surveyors used the metric system with the additional unit *caballeria*, which represented 42 metric hectares, the same as in Mexico. He exhibited a booklet published in 1910, in Spanish and English, entitled A Brief Statistical and Geographic Review, Including Revised Map of the Dominican Republic, on which map the only scale used was: 1 millimeter = 1 kilometer, and thought that especially for drawing and reading maps metric measures were a great convenience. He also exhibited a 28 by 63½-in. chart, published by the Cuban Department of Agriculture, Commerce and Labor at Havana, December 15, 1911, and signed by four government officials, giving all required technical data regarding 367 different kinds of wood. On this sheet the height and diameter of trees were given in meters, and the structural strengths expressed in kilograms per square centimeter.

After Mr. Sharpe had made further opposition to the resolution recommending consideration by the Council of the 40-in. meter, and Mr. Flanders once more had urged its adoption, Mr. Sharpe's motion, to lay this resolution on the table, prevailed by a rising vote.

Mr. Halsey, in closing the discussion, stated that the proposal for a 40-in. meter had been made frequently, the first time by Joseph Woodworth some fifty years ago, when it would have involved little difficulty to thus modify the meter.

His study of the New York schools convinced him that the study of weights and measures, instead of requiring a year, never exceeded three weeks. He said, "The judgment of the world is that the metric is not the better system, because the great majority of the people refuse to use it." He referred to France, where the metric system was first promulgated by law in 1792. In 1812, under Napoleon's reign, the law was repealed and people were allowed to return to their old system. He said this showed what the French people thought about this system, and that in South America they did not use it because they did not like it.

Upon motion of L. P. Alford, Mr. Halsey received a unanimous vote of thanks for his paper.

Written Discussions of Mr. Halsey's Paper

John H. Wigmore, Office of the Provost Marshal General, Washington, D. C., wrote that his attitude was based on the conviction that a system of weights and measures uniform throughout the commercial world, and decimal in its nature, was the obvious requirement; that he considered the Anglo-Saxon system as unscientific and impractical, and that the undoubted inconveniences of transition would be more than made up by the great convenience and economy of the future. Also that his opinion was strengthened by information he had received showing that in the engineering schools of the United States the metric system was used in practical work.

Representative James L. Slayden, Chairman of Committee on the Library, House of Representatives, Washington, D. C., wrote that he feared it would take considerable effort to secure the introduction of a really scientific and, when known, convenient system of weights and measures. He said that stupidity, inertia and momentary selfishness all operate to defeat the general adoption of the metric system in the United States. During his long and intimate acquaintance with affairs in Mexico, he had been greatly surprised to see how easily even the natives acquired a knowledge of the metric system, which was irresistibly making its way into the dullest understanding.

John B. Moore wrote that so long as Great Britain and the United States continued to do business in Latin-American countries with their old English units, those units were bound to be retained by those countries, unless their use was prohibited or penalized. He said that a uniform decimal system appealed very strongly to one's sense of convenience. On the other hand, he fully appreciated the fact that certain vested interests would be temporarily affected by the change, as well as the fact that changes are not generally desired by those who are not actually suffering from existing conditions.

H. J. Bingham Powell wrote that during his several years of experience as a civil and mechanical engineer in Peru and Bolivia, he found that in his line of work the metric system prevailed, but that manufactured articles imported from England and the United States, such as pipes, valves, cement, etc., were designated by their original units—inches, barrels, and timber in board feet. However, in workshops inches were in use rather than millimeters. In hydraulic calculations liters or gallons were used indiscriminately, the governments not attempting to make the metric system compulsory, since it would only inconvenience the people, who were satisfied with the mixed system of measurements.

William Jay Schieffelin, New York, whose drug business was founded in 1794, wrote that Mr. Halsey's report shows the chief obstacles to the wider use of the metric system in South America to be their business dealings with the English-speaking people. It certainly was not surprising to note the slow adoption of the metric system by the illiterate and conservative natives, but that was no reason for the people of the United States to be equally slow and to shut their eyes to the lessons of the past year, which

had demonstrated how quickly the whole people of this country could be informed as to an issue, if it was for the national good, and how within a few weeks the whole people would voluntarily cease using certain commodities, or change their habits of life, if it was for the country's good.

Mr. Schieffelin thought it ought not to take long to show a person having business dealings that a simple decimal system would save time and mistakes in merchandizing. In a wholesale drug house 30 per cent of the time of clerks could be saved if the weights and measures were metric. The fact that our blindness was not only hurting ourselves, but also our southern neighbors, ought to make us doubly anxious to put this reform into force.

Finally Mr. Schieffelin disapproved of the action of a small group of men, who were opposed to the adoption of the system, assuming an officially sounding name for their organization, and allowing their secretary to style himself a Commissioner.

Dr. A. E. Kennelly, Professor of Electrical Engineering, Harvard University, wrote that he could not agree with Mr. Halsey when he claimed in Par. 13 that Latin America was not metric. It was true, he said, that the use of the old units continued long after a new system had been introduced, especially among illiterate and the Indian people, but that ultimately the simpler system was bound to survive. None of the thirty-four countries that had adopted the metric system had ever revoked its decision, and those who had visited Continental Europe and the Latin countries knew from experience that the metric system was in universal use, and that if it were not satisfactory efforts would be made for the adoption of something better. Consequently he could not approve of the suggestion made in Par. 42 that "we should adopt the Spanish and not the metric system" if we were to succeed in selling goods to Spanish America. Nor could he agree with the idea suggested in Par. 9 that we should try to unify our system with that of the British Empire and South America, because then we should have to ask the International Metric Union, with its two basic units, the meter and the gram, to come into adjustment with our systems, with its dozens of units.

Professor Kennelly further said that the world was too small to permit of an indefinite continuance of a plurality of official systems. Sooner or later one system must prevail. When a simple and internationally recognized system operated alongside a complex and local system, it was only a question of time when the complex system must disappear. In fact, practically all scientific and electrical work was already being conducted and recorded in the metric system in every country. He stated that the American Institute of Weights and Measures could perform a great service to America and the world if it would, without bias, study means for bringing about international uniformity. That this could be done without abandoning existing plants, machines or apparatus was evidenced by the experience of other countries, only the adjustment would involve considerable readjustment of ideas, records and drawings. How to reduce this expense to a minimum, and how those burdened with the cost of changing over shall be protected and insured, were questions worthy of attention by the American Institute.

Mr. Gantt Presents His Paper on Efficiency and Democracy

In his paper Mr. Gantt establishes a relation between efficiency and democracy. He claims that the word "efficiency" has fallen into disrepute in connection with industry, and this at a time when efficiency is needed more than ever. He ascribes this to the fact that in the past the efficiency engineer has devoted himself exclusively to making more efficient the business of securing dollars, instead of producing more wealth. He says the production of goods for the benefit of the community is more important than the production of wealth for the benefit of those who control the industries. Also that the product of a factory should bear only the expense used to produce it, excluding the cost of idle machinery. There should be no idle machinery.

Mr. Gantt preferred to read only an introduction to his paper entitled Keeping the War Won. In this he pointed out that on the battle front war was competition in destruction. Behind the lines it was competition in production. He quoted Prof. C. R. Mann as saying that war was eight-tenths engineering, and that the engineer was the great production factor in the commonwealth. That through the efforts of engineers the war had been prolonged four years, and that it was certainly they who had won it. The next thing was to find out what part the engineer was to play in *keeping the war won*.

He then led up to the point where he hoped the engineer would be a more influential factor in the conduct of national affairs than heretofore, because he had demonstrated that *he knows what to do and how to do it*. He showed that when the war broke out leading business men had offered their services at Washington, but had found that their usual methods of doing business did not produce the required ships and shells, for they had been trained to operate for profits instead of for production. That engineers had attacked the problem in a different and successful way, he said, would be demonstrated during the discussion of his paper.

To supply the mechanical needs growing out of the war in sufficient quantity and in short time, progress charts had been compiled by engineers to show graphically the rate of production. These charts were used extensively by the engineering department of the Navy in the construction of shipyards, as well as in various large manufacturing establishments.

Mr. Gantt said that when the war broke out in Europe every one realized the necessity for greater production per capita, and it was the same in the United States. We should continue to improve our efficiency, and no machines should be allowed to be idle, so we could help those people who could do but little. If we did this we would also have the coöperation of the workman.

The system of keeping track of work done which Mr. Gantt had originated would be illustrated by a number of speakers who would show its successful application in the Ordnance Department, the Shipping Board, Emergency Fleet Corporation, and in numerous other places and private plants. He said that while the worker was studying efficiency, the engineer should study idleness.

Discussion of Mr. Gantt's Paper

Wallace Clark, the first to discuss the paper, made clear the task confronting the U. S. Shipping Board a year ago when it devolved upon that body to supervise ships afloat and building. He said the problem was to get ships to France and to bring to the United States food and raw materials. The former was done by the U. S. Army, and the latter by the Shipping Board. This Board had first ascertained what was needed at given times. Then it had listed its ships, which aggregated about 12,000, and it was here that the efficiency chart came in, inasmuch as it enabled one to have a graphical record showing in all required detail the daily movement of every ship, and to estimate beforehand the available carrying capacity in any direction for several months ahead.

The speaker then had a few typical charts projected on the screen. The first showed the rate of import of nitrate from Chile to this country. Of this, 800,000 tons, or more than half the output, was called for in the course of the year. To this work 175 ships were detailed. Charts, apparently 11 in. by 17 in. in size, were ruled up in such a way that the vertical columns represented days, weeks and months, proceeding toward the right. The descriptive side heads for the horizontal columns were placed along the left-hand margin. From these toward the right were drawn heavy black lines of differing lengths, the length of the line indicating either the quantity required up to the date indicated, or the actual output—or both if parallel lines. In the case of the ship record there was one horizontal column for each ship. One could tell from the record the weight of cargo, how long it took each ship to make a round trip, and when it could be expected to arrive. At the end of each month the various burdens could be added up and note taken of the progress made. It was possible to observe from these charts the over-supply as well as the deficiency of about 100 necessary commodities, and this furnished the required means for regulating the activity of the ships.

Another slide showed a similar chart applied to recording the progress made on certain field-artillery mechanisms. Each mechanism had to go through 67 different operations in manufacture.

The desired output was 10 mechanisms a day, and if the lines or bars on the chart were all of equal length, that would mean 70 mechanisms completed each 7-day week. However, the charts showed that some operations were proceeding at the proper rate, some were ahead, while others lagged behind, their lines being short, and therefore demanded special effort in order to meet promised deliveries of completed sets.

A. T. Clark, another member of the U. S. Shipping Board, then exhibited some slides of charts showing the movements of over 7500 ships employed in supplying coal from Chesapeake points to New England ports. Instead of a single horizontal bar, a series of circles and special characters were placed in the horizontal column for each ship, at the required dates. A circle represented the face of a clock, a closed circle denoting a full shift of 10 hours' work. A symbol inside of an incomplete circle gave the reason for any idleness. Thus, a wavy dash meant adverse tides or bad weather.

The cards were 11 in. by 17 in., each side for six months. For each month there were six horizontal lines, A to F. The dotted line A would show at some date a forward "L," indicating the date the ship left port. Some days later, on the same level, there would appear "L" turned the opposite way, indicating arrival at the distant port. The next distance, between brackets, indicated the time spent in port. Name of ship and tons of coal or other load carried were marked in the open space between the brackets. After the second bracket was written the name of the port bound for. While in port a separate symbol signified "discharging cargo," another "discharging ballast"; the relative position of the symbol indicating whether the work had been done by day shift or night shift.

On the chart was also indicated the time consumed in discharging the cargo each time, also how the ship was held up waiting for dock accommodation, and whether the ship had to undergo repairs which may or may not have interfered with loading or discharging. At the end of the month a cost statement could be prepared of the transportation cost per ton over this route. A new chart was then made providing a vertical column for each ship. The height of this column represented the total cost, and that was made up of the various items that enter into the cost of transportation. This showed the performance of each ship, the shortest column indicating the lowest cost per ton carried.

W. H. Blakeman submitted a written discussion which was presented by Mr. Gantt. Mr. Blakeman, he said, was a shipbuilder, now connected with the Cramp Shipbuilding and Engine Co., previously employed by the American Shipbuilding Co., headed by the Emergency Fleet Corporation, to help them to standardize work in shipbuilding. After looking over the Philadelphia plant, Mr. Blakeman devised a progress chart which greatly facilitated the production.

The facts intended to be conveyed by graphical straight-line charts included the following:

1 Show the work to be done on various parts of the vessel
2 Indicate manner of doing it at the shipyard decided on
3 Indicate time of completion of all parts.

The adopted form of schedule and progress charts record:

a The work to be done in groups
b When it is to be done.

Vertical columns on the charts represented days. Horizontal columns applied to the various items of work. Along these horizontals were marked various characters and symbols showing state of progress at the date they appeared. The rate of receipt of structural material was thus apparent from the charts, the rate of erection, rivet driving, installation of equipment, etc. The Emergency Fleet Corporation was instrumental in having this simple and effective chart system introduced at 90 per cent of all the shipyards in operation in the United States.

S. B. Barrows, a representative of the Naval Aircraft Factory, Navy Yard, Philadelphia, then described and had shown on the screen a number of the Gantt type of progress charts which had proved to be very valuable in systematizing the proper rate of production of completed airplanes.

James J. Reynolds then illustrated on the screen charts devised, with the assistance of Mr. Gantt, for accelerating the production of artillery ammunition at the Frankford Arsenal. Blueprints of these charts could be sent to Washington at regular intervals, and thus information imparted without entailing the vast amount of correspondence previously required.

H. J. Swallow, of the Emergency Fleet Corporation, also had shown a number of record charts that were found necessary for procuring in due time the thousands of articles necessary in the completion of ships.

Captain Charles E. Davis illustrated the use of the Gantt progress charts as applied to the manufacture of fuses. He stated that the charts had been of great service in registering the rate of production and the relative efficiency of the departments.

John E. Mullaney showed charts used for greatly facilitating the production of complete machines, and indicating at once when a portion of the equipment was not producing its rated output.

Major Frank B. Gilbreth then made a motion, which was seconded by C. B. Johnson and carried, that Mr. Gantt be asked to submit to the Society a general progress chart for the use of all businesses, embodying his latest ideas—a chart that could be used as a standard.

Walter N. Polakov was in hearty accord with Mr. Gantt's ideals in regard to efficiency and democracy. He thought the time had now come where a reorganization of the industrial system in the United States was in order, to supersede the old business system which involved so much waste. He commended the British Ministry of Reconstruction for stating that "the work now for the world is to establish fresh and fair conditions wherein social and industrial life may thrive unhampered as never before."

He said the old standards were definitely changed, as had to be the inevitable outcome of a war waged to make democracy safe, and that a man was judged today not by the size of his bank account, but by his record of deeds. In his opinion, the task for engineers is threefold: (1) We should lead in extending credit and authority to those who know how to do things and whose records show that they have done them. (2) In industrial relations we should adopt the principle of "no secret agreements," so that workmen would know what the management does, and one manufacturer would know what the others were doing, and that the people should know what things cost. (3) We should control all our natural resources the same as public funds are controlled, and not allow needless waste. As an organized body of engineers we should set an example of a government by facts.

Mr. Gantt, in closing, said that the exhibition of many performance charts from all sorts of plants had been for the purpose of proving their wide applicability.

After the war had broken out he had gone from the Frankford Arsenal to Washington to see General Crozier to discuss questions of organization. His method of charting production appealed to the General, and it was introduced at once, so that by November 1917 about three-quarters of the production in the Ordnance Department was charted by it in detail. In addition the method was welcomed by a large number of plants throughout the country, as had been just shown.

It developed later that in November 1917 Professor Schneider, Dean of the University of Cincinnati, had also been invited to Washington by General Crozier to confer on labor problems. Early in December the Dean handed Mr. Gantt a copy of his report made early in December 1917 to General Wheeler, at that time General Crozier's first assistant, in which he had recommended for adoption by the entire War Department the production charts already successfully applied by the Ordnance Department. Mr. Gantt said that just about that time Congress met and criticism developed. Business men from all over the country went to Washington to help straighten out matters. These men were mainly financiers and salesmen not acquainted with production. They did not understand that Washington's problem was one of production and hence that an organization such as General Crozier's was built primarily for production. The organizations which they understood were built primarily for profit; but the country did not need profits, but goods.

The result was that General Crozier was ousted and his whole plan of organization of the Ordnance Department went to pieces.

Although General Crozier's plans had been thus disrupted by his successor, a start on the same lines had already been made in the U. S. Shipping Board, and from there the methods gradually spread to other Government departments, including finally the arsenals. Had the original plans of General Crozier been carried out, Mr. Gantt believed there would have resulted less trouble in the supply of ordnance and many lives lost in France would have been saved.

EFFICIENCY AND DEMOCRACY[1]

By H. L. GANTT, NEW YORK, N. Y.

WHY has the word efficiency, which should stand for so much, fallen into disrepute in this country? That it has fallen into disrepute cannot be gainsaid, both with the business man and the workman. We all recognize the importance of both individual and collective efficiency. This being true, there must have been some fatal error in the management of the campaign which at the end of twenty years has made the very name a byword.

It is not to be questioned that many men who have devoted their time to this subject have very much improved our industrial processes and the productivity of our manufacturing plants. Yet in the mind of the average business man or mechanic the term "efficiency engineer" raises a feeling of hostility.

Today we need efficiency, both individual and collective, to a far greater extent than we ever needed it before, yet it seems that we must do the work of promoting it under some other guise if we would really have it accepted and approved.

To some of us the reason seems plain, simply that we have in the past measured the "efficiency of our business" by the dollars acquired rather than by the goods produced. The efficiency engineer of the past has in too many cases devoted himself exclusively to making more efficient the business of securing dollars. In other words, he has served the business system primarily in the accumulation rather than in the production of wealth.

A business system bent on the accumulation rather than on the production of wealth, which would even curtail the production of wealth if thereby a larger measure could be brought into its own coffers, must needs finally run to the limit of its tether, and a method which makes more efficient such a system shortens the time which it has to run. An efficiency engineer who, consciously or unconsciously, served the business system in the exploitation of workmen, necessarily got the ill-will of the workman. He later got the ill-will of the business man, who found that the amount of wealth he could get by exploitation was strictly limited. I am not claiming that all efficiency engineers have done this, nor that even those who have done it have been conscious that they were producing a condition to which there must be an end. They were simply serving "business as usual," which puts more effort in harvesting the crop than in producing it.

When the great war broke out in 1914, it became evident to all those who gave it serious consideration that the production of goods for the benefit of the community, and not the production of wealth for the benefit of those who control the industries, was the task which had been set the nations engaged. It took England more than a year to learn this lesson, and we should have been fully prepared for it in 1917 when we were drawn into the maelstrom. That we were not prepared for it, and that many believed we could still continue business as usual, is now history. We have learned, however, that production for the benefit of the community was the only basis on which we could carry the war to a successful conclusion. This has been emphasized by the elimination of "non-essential" industries.

There is another reason why the term efficiency has been brought into disrepute. In the past our cost-keeping methods have always loaded on to the part of the shop which produced the goods the total expense of the shop, including the part that was idle. For instance, in a shop having two expensive machines, it was the habit to load on to the product the expense of both machines, whether the goods were produced by one or by both. Under such conditions, if one machine did the work of two, the product was still charged with the expense of both, and the full benefit from the increased efficiency was not apparent to the owner, who saw only the saving in wages. He did not see the saving in plant. He did not comprehend clearly that if he doubled the output of his machine he could double the output of his plant without additional expense. In other words, that he was also making his capital twice as efficient. It is hard to see why he did not see this, except that the system of cost keeping seemed designed to hide it. The term "efficiency" then seemed to have no connection with capital on investment, but only with labor.

Under such conditions there was but little inducement to the owner to make his machines produce more, and the reverse of an inducement to the workman, who was thereby laid off or saw his friend laid off. This fatal error which caused the opposition of the workman, and the lack of sympathy on the part of the employer, was evidently due to a false accounting system, which was devised to put all the burden of inefficiency on the workman.

When the great war started in 1914, and the wheels of industry slowed down to such an extent that it was impossible for the product turned out to bear the expense which had previously been distributed over a production three or four times as large, most people said, "These are extraordinary times; therefore we shall have to lay our cost system aside till the war is over."

Some people, however, realized that a system which is not good for an emergency, when it is most needed, has something radically wrong about it, and set to work to find out what the flaw was, and this was the answer they arrived at:

The product of a factory must bear only the expense used to produce it. It cannot bear the expense of idle machinery which did not contribute to its production. This statement is such a radical departure from the ordinary cost-keeping system that it produces a shock to the business man who has a theory that he must somehow or other get back all of his expenses. He seems to feel that he is entitled to interest on all the money he has invested, whether it produces anything or not. Under such conditions he is not seriously worried so long as he can sell his product for a price high enough to give him the profit he considers himself entitled to.

Some of the keener business men, however, have seen the flaw in this argument, and have realized that idle capital is no more entitled to wages than idle labor, and have begun seriously to study their plants to find out how they can use them to their full capacity. The result of this investigation is twofold:

a It does not result in laying off men, but gives employment to more men, which secures the good-will of the worker.

b It not only reduces the expense of maintaining machinery in idleness, but turns out a greater product from which revenue is gotten.

Some would say that this is a beautiful theory, but it doesn't work that way. I answer unhesitatingly, after more than three years' trial, that it does not work that way and that none of those people who have adopted it would for a moment think of going back to the antiquated method of cost keeping which they have given up.

The keynote of such a system is the elimination of idleness and the production of goods. Moreover, there is no antagonism in such a scheme between employer and employee, for each gets the reward for what he does.

To the conservatives this would seem almost revolutionary, and fraught with consequences of which they cannot see the end, but it is democratic and absolutely in harmony with the patriotic doctrine which is being preached. It enables us to change automatically our slogan of "business as usual" into "business for production and victory."

In a few words, then, if we eliminate our false cost-keeping methods, and put in those that are correct, we shall not only benefit both employer and employee, but go a long way toward the democratization of industry.

[1] Presented at the Annual Meeting, December 5, 1918, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. All papers are subject to revision.

RAILWAY ARTILLERY

By COLONEL JAMES B. DILLARD,[1] U. S. A.

CONTRARY to general belief, railway artillery is not a recent development of ordnance. In 1863 a 13-in. mortar was used by the Union Army against the defenses of Richmond. It weighed 17,000 lb. and was mounted on a flat car having eight wheels. Some 4-in. artillery pieces were also used on railway mounts. In 1883 Gen. Joseph L. Brent wrote a book on the subject of railway artillery, in which he prophesied accurately its development as has occurred during the European war, and even anticipated the armored automobile and the tank.

Both the British and Boer forces in the South African war utilized naval or coast-defense guns on railway cars. In the campaign for the relief of Ladysmith the British used four 12-lb. naval guns on flat cars. Armored trains, mounting field guns, were also used.

In 1893 the Schneider Co., of France, brought out a type of disappearing carriage mounted on wheels for road transportation. The St. Chamond Co., of France, brought out a similar design, but mounted upon a railway car. The weight of this 4.7-in. gun and mount was about 20,000 lb.

In 1900 the Schneider Co. made up a 155-mm. howitzer mounted upon a car which closely resembles the design used today. The Skoda Co., Austria, brought out a design of truck mounting to secure greater mobility for light coast-defense guns calculated to travel a short distance only.

A few years later the St. Chamond Co. had improved its 1892 model, the gun still having a disappearing carriage, but well mounted on a short railway truck equipped with rail clamps to secure increased stability under firing strain. It had also a horizontal armored shield overhead for the protection of the gunner. Since then it has been found that the rail clamps are suitable only for guns smaller than 6-in., as heavy guns pull the rails and ties out of the roadbed.

About this time the Krupp works in Germany built a 4.7-in. railway gun which was simply a wheeled road gun with disappearing carriage placed on top of a flat car. Rail clamps and outriggers appear in this design; the latter consist of swinging brackets with vertical hinge pins and jack screws at the outer ends, and serve for bracing the car during firing.

In 1912 the Schneider Co. brought out a design for a 200-mm. howitzer which is now typical of our present ideas for mounting guns up to 8-in., and mortars up to 12-in. The howitzer is mounted on the usual type of barbette carriage, in that it can fire in any direction, and is placed upon a drop-frame car. A folded platform is used, also outriggers.

Fig. 1(*g*) shows an American design of about 1912 for a 4.7-in. howitzer, which is very similar to the Schneider.

In the foregoing cases the main object was to devise a mobile weapon for coast defense, but in the European war the use of railway artillery was confined to field operations, no coast-defense necessities having arisen.

Types of Cannon Used on Railways

The types of cannon mounted on railway cars are the same as those used in field and seacoast artillery, and include mortars which are 9 to 12 calibers (diameters) long; howitzers 15 to 20 calibers long, and guns which vary in length from 30 to 50 or more calibers.

Mortars are used for "plunging fire"—they are fired at angles of elevation of 45 to 65 deg., the projectile dropping nearly vertically on its objective. The mortars used by the American Army are of 12-in. bore, 9 to 15 calibers long, and their muzzle velocity ranges from 900 to 1800 ft. per sec. On railway mounts they can be fired at angles of 20 to 65 deg. The weight of projectile is 700 lb., and the maximum range is 15,500 yd. The modern trend is to abandon the mortar, because its only advantage is that it is cheaper and will perform certain limited functions as well as the howitzer.

Howitzers are fired at angles of elevation from 30 to 65 deg. The American Army uses howitzers of 6 to 16 in. bore having a muzzle velocity of from 1500 to 2000 ft. per sec. Only the 16-in. howitzer has been mounted. It fires a 1600-lb. projectile with a muzzle velocity of 2100 ft. per sec., which, at a 45-deg. elevation, gives a range of about 24,000 yd.

Guns are used for accurate work at long range. The German guns which bombarded Paris were doubtless 60 to 70 calibers long. Until the present war, guns were normally used for direct fire at elevations not exceeding 20 deg. Recently, however, they have been used at elevations up to 45 deg., to obtain the maximum range possible.

Accuracy of firing at these high elevations and long ranges is, however, small, as the German gun required a target of the size of the city of Paris and was not always able to hit even that. The range of the guns in our service, which vary from 8 to 14 in. is from 13 to 30 miles. The projectiles vary in weight from 200 lb. for the 8-in. gun to 1400 lb. for the 14-in.

The accuracy life of the mortar is estimated to be about 5000 rounds; of the howitzer, about 2000 rounds; and of the gun, about 150 rounds. After firing this number of shots, the fire becomes inaccurate owing to the wear in the barrel.

Problems of Design

The two main problems in the design of railway mounts are transportation and provision for stresses due to gun firing. The transportation problem requires that the closest consideration be given to weight, minimum railway clearances, and a full understanding of car design, especially as pertains to the trucks. To handle mounts weighing 600,000 lb. and upward a system of trucks must be utilized that combines perfect equalization of loads and flexibility.

The condition of road beds in France has limited all axle loads to not over 17 metric tons. For mounts designed for use only in the United States this might be increased to 22 tons, but so far all the railway mounts, with the exception of the 8-in. gun, have been limited to the maximum weight allowed by the French railways.

The railway clearances set by tunnels, bridges, third rails, etc., present a considerable handicap and impose several limitations upon the design. Fortunately American and French line clearances differ very little and provide for a maximum height of about 14 ft. at the center of the track and a width of 10 ft. Fig. 2 shows on the right the French, and on the left the American, clearance diagram as applied to the 8-in. gun railway mount.

The American Army has made a careful study of the clearance diagrams of all United States railways to insure that all our mounts will be capable of being used in any part of the country. With guns up to 8 in. and howitzers up to 12 in. the limitations to design set by the railway clearances are slight, but in the case of howitzers of 16 in. and up, and with guns 12 in. and up, the limitations of the clearance diagram begin to be severely felt.

The gun is elevated around its trunnions, which are usually located at the center of gravity of the tipping parts. The breech end of a 12-in. gun when tilted around its trunnions would strike the cross-ties at about 30-deg. elevation, 25 deg. elevation for the 14-in. gun, and a less elevation for the 16-in. gun. In order to secure a greater elevation it is necessary to modify the design by any one of the following methods: The gun is artificially thrown out of balance by placing a weight at the breech end. A mechanical counterbalance device, such as springs or compressed air, can also be used. In this case a column of springs or a compressed-air column is so lined up with the elevating gear as to compensate for the muzzle preponderance when the

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[1] Engineering Division, Ordnance Department, Washington, D. C.

Lecture, with slides and motion pictures, delivered at the Annual Meeting of The American Society of Mechanical Engineers, New York, December 5, 1918.

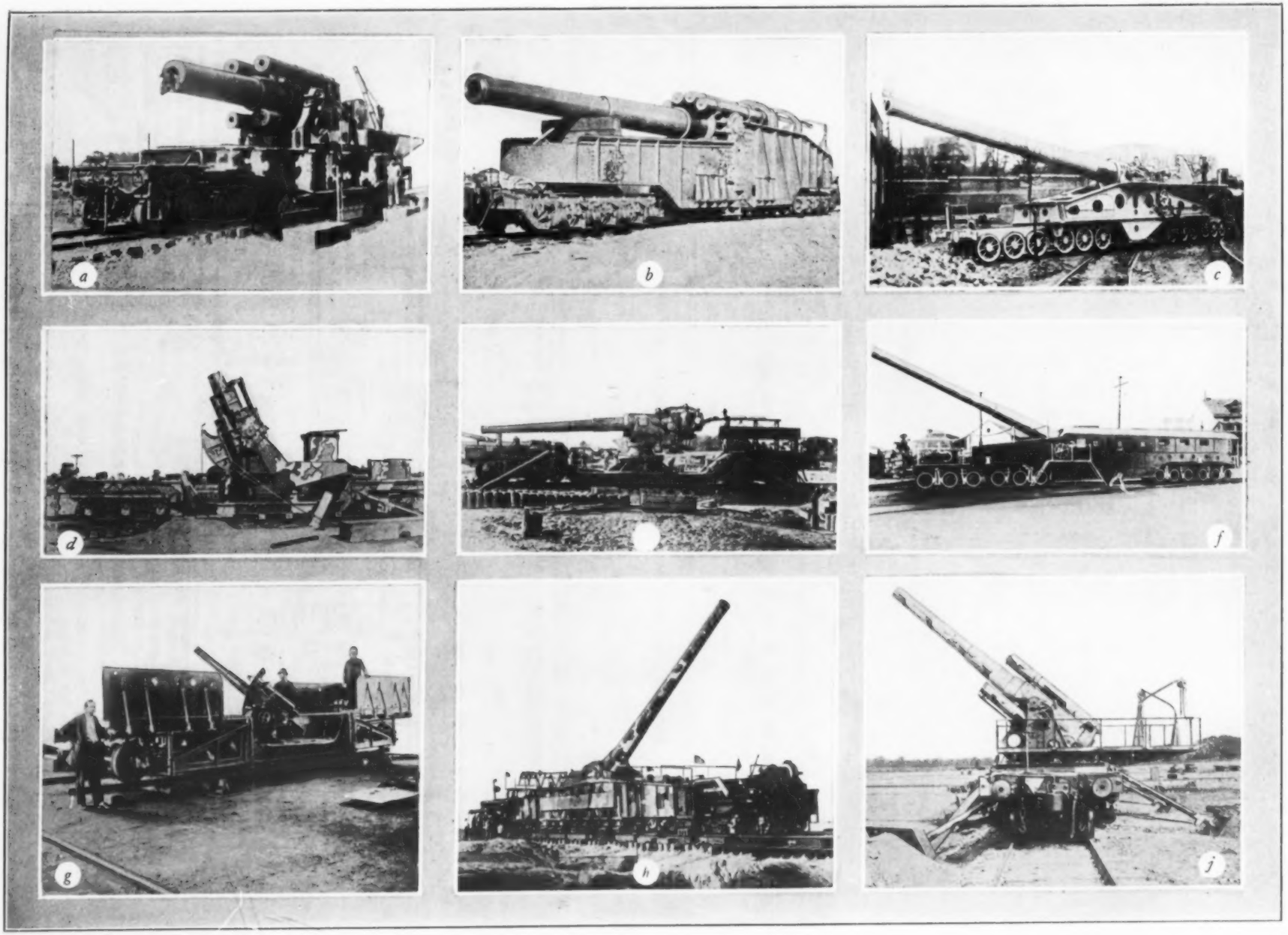


FIG. 1 FRENCH AND AMERICAN RAILWAY ARTILLERY

(*a*) 16-in. Howitzer, Model 1918, Elevation up to 65 Deg. (*b*) American 14-in., Model E, Railway Mount for Seacoast Defense. (*c*) French (St. Chamond) 340-mm. (14-in.) Railway Gun. (*d*) 12-in. Mortar Railway Mount. (*e*) 7-in. 45-caliber Navy Gun, Barbette Carriage, Mounted on Standard Drop-Frame Car. (*f*) 14-in. 50-caliber Navy Gun Railway Mount. (*g*) American 4.7 in. Railway Howitzer of 1912. (*h*) Sliding Railway Mount, French 305-mm. and American 12-in., Elevated 45 Deg. (*j*) Method of Bracing Drop-Frame Car Opposite to Firing Side.

trunnions are located to the rear of the center of gravity of the gun. A third method is to provide a top carriage carrying the trunnions of the gun and to raise this sufficiently high into firing position by means of hydraulic jacks to enable the breech to clear the ties.

have been utilized in the various designs of railway mounts, but the simplest and best is the use of the counterweight, as there are no moving parts involved.

In providing for stresses due to gun fire, it must be remembered that the mounts should permit of elevation up to 45 deg. in

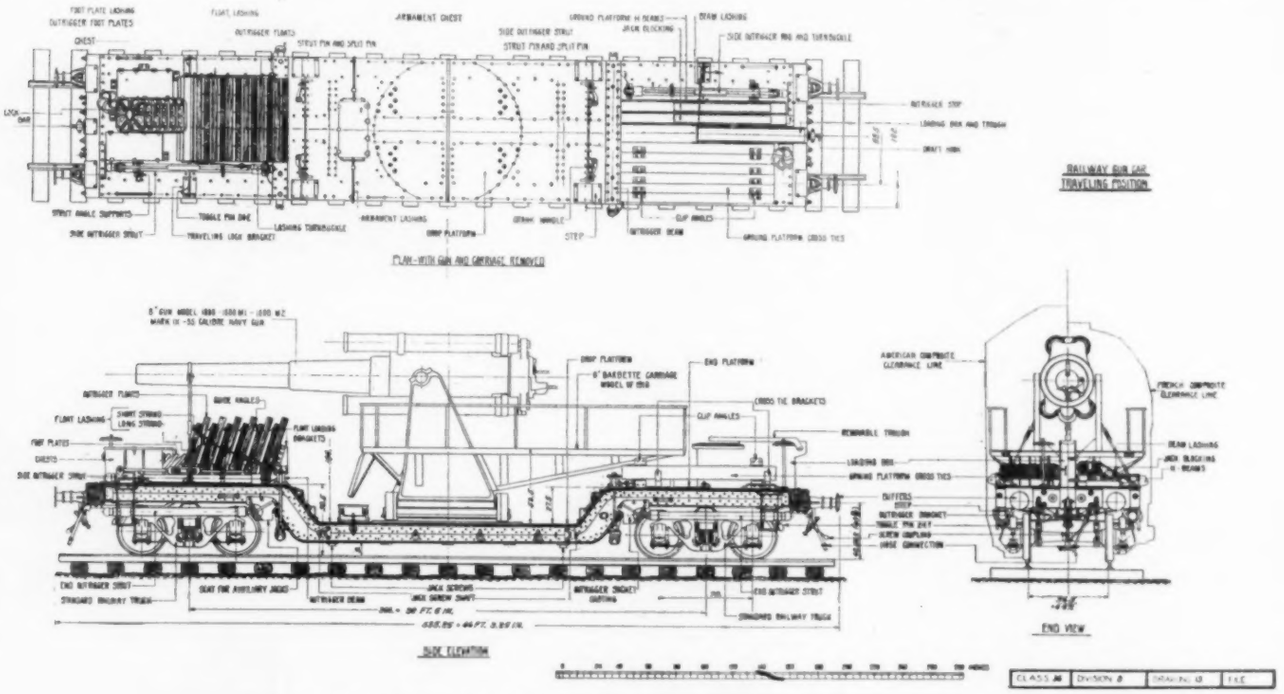


FIG. 2 8-IN. 35-CALIBER NAVY GUN RAILWAY MOUNT IN TRAVELING POSITION

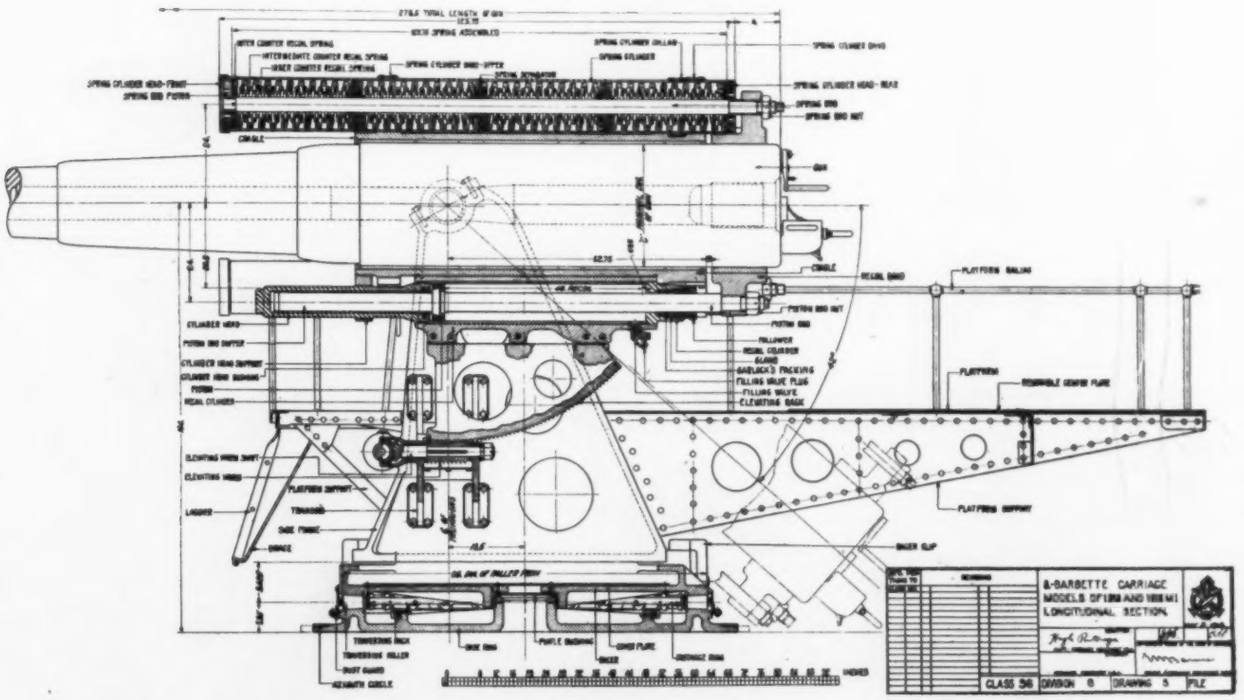


FIG. 3 8-IN. BARBETTE GUN CARRIAGE, MODEL 1918

The fourth but least desirable method is to dig a pit in the line of the railroad track, but this requires a specially constructed track to bridge over the gap caused by the excavation, besides there may not be time available to make the excavation, especially when the ground is frozen. All of these alternatives

order to secure the maximum range obtainable. The widest possible traverse should be aimed at, 360 deg. if possible. It is comparatively easy to obtain the elevation desired, except with the 16-in. size and upward, but it is not possible to obtain more than about 10 deg. total traverse with the railway mount unless

considerable time is allowed for preparing a firing platform other than that provided by the car itself.

For guns up to 8 in., and howitzers and mortars up to 12 in., an especially designed drop-frame flat car can be used and the barbette carriage of standard construction placed upon the car. Fig. 2 shows the 8-in. gun railway mount, model 1918, as designed by the Ordnance Department.

With larger guns various designs have been produced for use in the present war. Most of them provide for a 2- to 6-deg. traverse on either side of the center of the gun, greater change of direction being obtained by using the curved track. Even this arrangement places a handicap upon the tactical uses to which these guns may be put.

Barbette Carriages for All-around Fire

These carriages are of the standard barbette type. In fact, the carriages may be removed from the flat car and mounted upon a concrete base as is the practice in many of our seacoast forts. The carriages are always provided with recoil and counter-recoil mechanisms. The force of recoil is checked by forcing a liquid in the recoil cylinder, usually oil of about 0.85 specific gravity, through two or more orifices cut in a piston, the piston rod being attached to the breech of the gun, while the recoil cylinder is attached to the cradle.

Counter-recoil is accomplished by means of helical springs, usually about four columns, or by means of compressed air contained in an air bottle located above the center line of the gun. The 8-in. gun carriage has a spring counter-recoil mechanism as shown in Fig. 3, while the 12-in. mortar carriage has the compressed-air counter-recoil mechanism (air recuperator) illustrated in Fig. 4.

With the larger guns compressed air is preferred on account of the less bulky mechanism required. Figs. 3 and 4 show also the type of elevating mechanism used, which includes a worm and worm-wheel sector. The traversing gear consists of a turntable resting on conical rollers, which in turn rest upon a bedplate attached to the body of the car.

The design of limited-traverse railway mounts for guns and howitzers presents but few engineering difficulties. The principal one relates to the height at which the trunnions must be placed in order that the breech of the gun may not interfere with the road track. Fig. 1(*b*) is typical for this type. The trunnion of the gun rests upon girders which are supported at each end by trucks. It is evident that by means of the curved track a reasonable amount of traversing is available.

In the case of the all-around firing type of mount for large guns and howitzers, it is necessary to have some form of firing platform on account of the varying direction in which the firing stresses may act.

During 1915 the Ordnance Department started the design of the 14-in. mount, Model E, shown in Fig. 1(*b*). A base ring with a conical roller path is carried in a separate car, and is to be set into the ground. The gun and mount on its traveling trucks are run over the base ring so that center of the car is over the center of the base ring. The mount is then jacked up so that the traveling trucks may be disengaged from the girders. The mount is then lowered so that it rests upon the conical roller path, where it is free to be traversed in any direction. This arrangement has also been applied to the construction of a 16-in. howitzer railway mount.

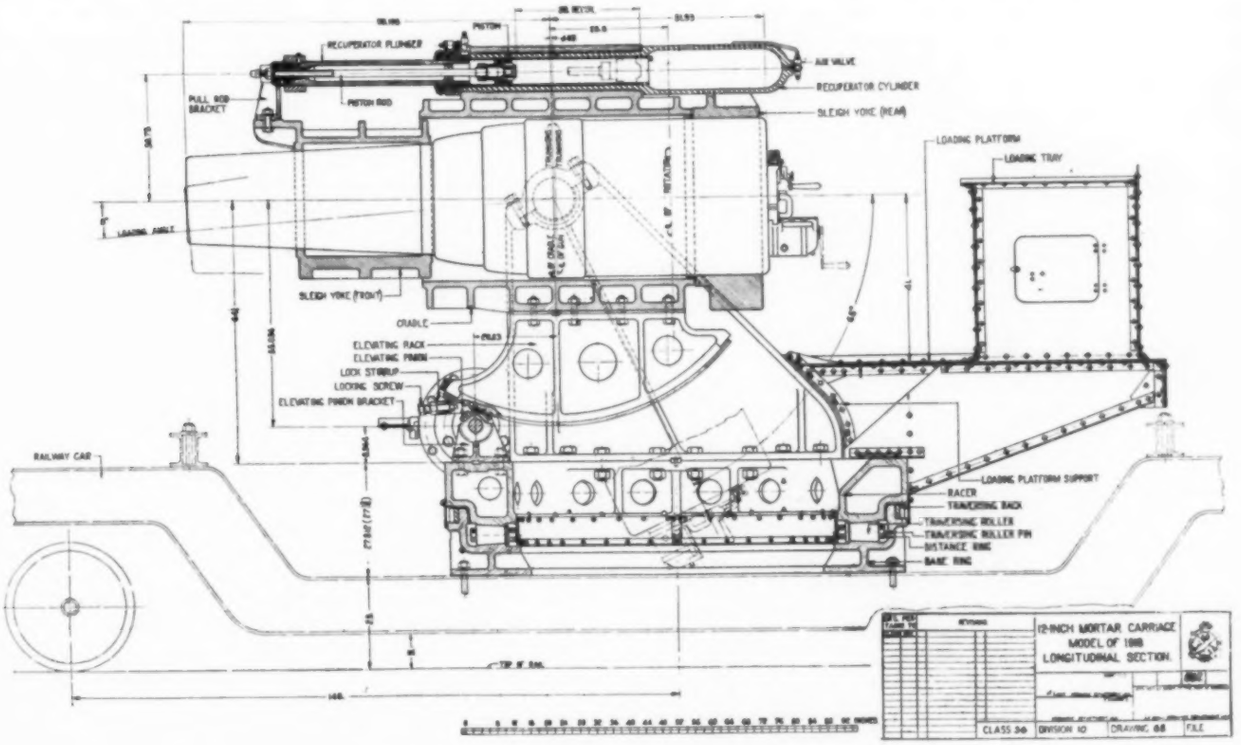


FIG. 4 12-IN. BARBETTE MORTAR CARRIAGE, MODEL 1918

Foreign Types of Railway Artillery

A number of French howitzers have proved very satisfactory during the present war. They include the 190-mm. (7.6-in.) and the 240-mm. (9.6-in.) howitzer railway mounts with movable top carriages. These mounts are not provided with a traverse mechanism and therefore must be moved along a curved track to obtain azimuth setting. Due to the lack of long-range field artillery at the beginning of the war it became necessary for the French Government to construct with the greatest of rapidity considerable quantities of railway artillery, and to utilize naval and coast-defense guns already in existence. Schneider & Co. then designed what they termed a "glissement" or sliding railway mount, an example of which is shown in Fig. 1(*h*).

These mounts consist of two six- or eight-wheel railway trucks

connected by heavy girders which carry the weight of the gun. These girders are provided on the lower surface with cross-beams connected to the girders by jackscrews. Before firing, these cross-beams are lowered on firing rails thus relieving the trucks of the firing load, which is transmitted directly to the roadbed. No recoil mechanism being provided, the recoil force is taken up by the friction of the entire mount sliding backward on the firing rails.

No traversing mechanism is provided, direction in azimuth being obtained by constructing the firing track on a curve. After the shot is fired, it is necessary to move this gun forward to its original position which is done by hand through a system of sprockets and chains to turn the wheels of the trucks.

Fig. 1(*c*) shows a 340-mm. (14-in.) railway gun built by St. Chamond. The gun rests in a cradle, which is a large ribbed casting through which the gun slides in recoil. The cradle has trunnions which are carried in trunnion bearings on the top carriage, which is supported by the car frame mounted on trucks. The firing emplacement consists of a pit into which the gun recoils when firing at higher angles. Two platforms which act as a foundation for four jacks provided with large timber floats prevent the car from recoiling along the track. The shock of recoil is absorbed by hydraulic cylinders and the gun is returned to battery by an air recuperator. The top carriage can traverse about two degrees.

The 14-in. British railway gun is almost identical in design with Fig. 1(*c*). The gun is 62.5 ft. long, weighs approximately 183,000 lb. and is mounted in a cradle whose trunnions are supported by two longitudinal girders carried on two sets of four-axle trucks. The total weight of this mount is approximately 545,000 lb. With this gun a traverse of 2 deg. on either side of the center line is provided for. In order to secure a high elevation the gun is placed forward in the cradle so that it has a considerable amount of muzzle preponderance. This unbalanced weight is compensated by a pneumatic counterbalance device so that the piece may be easily elevated. The recoil mechanism consists of two hydraulic cylinders and the gun is returned to battery by a pneumatic cylinder. The elevating mechanism consists of a screw operated by a gasoline engine.

American Types of Railway Artillery

Fig. 1(*e*) shows a barbette carriage mounting a 7-in. 45-caliber gun, a design developed by the Ordnance Department. The carriage and gun were originally designed by the Navy Department and were mounted on certain battleships and cruisers. A number were available for army use and were mounted on the railway car with drop frame as shown. This car construction is now standard with the Ordnance Department for similar sizes of guns and mortars and provides for 360 deg. traverse. Fig. 1(*j*) shows the construction of this type of mount. The trucks used are Pennsylvania Railroad standard 70-ton freight-car trucks. A firing platform and outriggers are necessary to brace the mount against the ground to take up firing stresses. Each outrigger consists of a pipe attached by a ball-and-socket joint to the car frame, the lower end having a screw jack which rests on the wooden float sunk in the ground. The jacks for raising and lowering the car are built in the structural part of the frame and are operated by ratchet levers. The total vertical movement required for the insertion of the oak cross-ties in the firing platform is about one inch. The mount may be put in firing position by a gun crew in 15 to 20 minutes.

The 1918 model 8-in. gun railway mount, which uses the same barbette carriage as the 7-in. gun, Fig. 1(*e*), may be elevated from 0 deg. to 42 deg. It fires either a 200- or 300-lb. projectile at a maximum muzzle velocity of 2000 ft. per sec., and has a maximum range of about 23,000 yd.

By means of special 8-wheel trucks it is possible to transport this mount over a 60-cm. (24-in.) narrow-gage track. This 8-in. mount weighs about 180,000 lb. and it certainly is a great advantage to be able to transfer it to a narrow-gage track which is the kind used at the battle front in order to better conceal operations. On the narrow-gage track a speed up to 15 miles per hour is feasible. The Ordnance Department, who developed this mount in its entirety, considers this artillery piece to be the last word in railway mounts. It is also the only mount of its kind in existence.

Fig. 1(*e*) shows a 12-in. mortar placed upon the same car as the 7-in. and 8-in. guns, except that 6-wheel trucks are used in place of the standard 70-ton 4-wheel trucks. It is also adapted for narrow-gage track and makes a highly satisfactory piece for field and seacoast work.

Fig. 1(*h*) represents also the American sliding type of railway mount. It has neither recoil mechanism nor traveling mechanism. It is a 12-in. gun and the entire mount is about 105 ft. long and weighs 575,000 lb. It can be transported at the rate of 40 miles an hour over standard-gage road bed and will go around any curve met with in American or French railway practice. When the gun is to be used, the track is laid on a curve and the gun is turned on its objective by moving the mount back and forth by means of a gasoline engine. A special hand translating mechanism is used for spotting the mount in the exact position.

The principal parts of the car body consist of bridge girders, span bolsters connected to 8-wheel trucks, trucks, bearing stringers and sleepers, lifting wedges and loading mechanism. The gun is supported on trunnion beds, which are carried on top of the girders. The gun can be elevated from — 4 deg. to + 40 deg. The slippers consist of wooden beams placed crosswise under the car body, supported by the elevating wedges which raise and lower them into position. The bearing stringers are made up of eight lines of 12-in. steel I-beams. The lifting wedges are operated by handles, one man being placed at each handle. No special track preparation is necessary other than to lay the stringers and to see that the track is well ballasted. In the firing the entire piece slides to the rear for about 15 ft. and after each shot the mount is returned by means of the power winch and the hand translating device. The 12-in. gun used is 50 calibers in length and is one of the most powerful in existence. The muzzle velocity is 3200 ft. per sec. and the range is approximately 30 miles.

Fig. 1(*a*) illustrates what is considered the very latest type of railway artillery. This mount carries the 16-in. howitzer developed by the Ordnance Department in 1918, which is the most powerful howitzer known. The carriage embodies the features which are considered the most desirable in handling railway artillery for field-army use. The howitzer can be fired on this mount directly from the trucks on standard-gage track. The track emplacement and bearing stringers to take up the shock of recoil are done away with. The shock of fire is taken care of in the recoil and in pushing the car backward along the tracks on its own trucks. For this duty unusually heavy trucks are necessary to absorb the shock and to transmit it to the roadbed. The piston-rod pull is approximately 670,000 lb., which force is transmitted directly to the trucks. Two 12-wheel trucks are used with specially designed frames and springs. The top carriage is pivoted at its forward end, and arranged at its rear end so that 12 deg. traverse is all that is necessary for range correction, the range direction being secured by running the mount on a curved track. A gasoline winch is placed on the forward trucks which pulls the mount back to its original position by means of a cable attached to a rail clamp. Four columns of counter-recoil springs are used. The loading arrangement is the American style of gravity platform, which permits the projectile to slide into the breech.

Fig. 1(*b*) illustrates the 14-in. Navy gun railway mount built by the Navy Bureau of Ordnance. Some 14-in. 50-caliber guns that were not required aboard ships were utilized and mounted on railway trucks. Four 6-wheel trucks are used and connected by span bolsters upon which rest the body girders. Top girders support the gun and its cradle by means of the usual trunnion and bedplate. A cab, consisting of ¼-in. armor plate, encloses the body girders, as well as the breech end of the gun. The emplacement, of structural steel, is carried on special cars and is placed in position by a locomotive crane. Four jacks are used to relieve the trucks of the firing shot. Five degrees traverse

is secured in place, and 45 deg. elevation. This amount of elevation necessitates a pit of 9 ft. in depth.

AUXILIARY CARS

All railway artillery operates in batteries which are made up of four gun mounts with their auxiliary cars, including ammunition firing cars, control cars and supply cars. The ammunition car is especially designed and standard for all railway artillery. It is a steel car provided with a trolley I-beam and hoist for handling ammunition. The ammunition is stored in racks, Fig. 5, which are so arranged that they can be taken down and the car used as an ordinary box car. The fire-control car is a standard Government 30-ton box car provided with windows. It is used as an office by the battery commander and contains fire-control instruments. The supply car is a standard Government 30-ton flat car on which is carried the auxiliary equipment and the supplies that are to be used with heavy railway artillery.

TACTICAL USES

The uses for railway artillery are considered under two principal heads, namely, against land targets with field armies; and for coast defense. Guns, howitzers and mortars are required for these purposes.

For use with field armies the ability to bring the mount into and away from firing position is of more tactical value than an extremely wide traversing angle without moving the location of the gun. On the other hand, for sea-coast defense a wide, quick and accurate traverse without changing the location of the gun mount is an absolute essential. One of the greatest values which railway artillery can have to the United States is the ability to concentrate large numbers of guns within any given strategic area. If guns are made up in trains, they can be moved quickly from one place to another, therefore, considerable economy will be obtained in securing proper protection for any part of our coast line and for any harbor.

In the present war railway artillery was used for the following kinds of fire: (*a*) Fire for destruction; (*b*) fire of interdiction; (*c*) counter battery work; and (*d*) reprisal bombardment.

Fire for destruction includes the demolition of railway centers, depots, fortified works, bridges, etc. For this work high-angle or plunging fire is desirable in order that the projectiles may bury themselves in the ground before exploding, thus causing a large crater to be formed and securing the maximum amount of destruction. For this kind of fire the use of howitzers and mortars is indicated. If it is required to obtain a number of direct hits on a small target at a range of 20,000 to 25,000 meters, it would be better to use a considerable number of total rounds which can be obtained economically with guns having a long accuracy life, namely, howitzers and mortars. Beyond the range of howitzers, guns must be used. Rapid firing not being essential, the sliding type of gun mount is entirely satisfactory.

Interdiction firing includes destruction and interruption of traffic on lines of communication. It may be desirable to keep certain sections of a railway line out of commission or to shell sections of some important road over which supplies of men must move. In this case the target is usually small and therefore greater accuracy of fire is necessary. As time is required to repair the damage, intermittent shelling will suffice. Two to four well-placed shots a day are sufficient to keep a railway line out of commission. For this work, therefore, it has been the practice to use very long-range guns with a sliding type of railway mount.

Counter battery work includes the destruction of such enemy batteries as are out of range of the army artillery. The army artillery consists of guns of about 6-in. caliber and howitzers of about 9.5-in. caliber. The range is 15,000 to 18,000 meters, whereas all railway artillery should have a minimum range of about 23,000 meters and preferably 25,000 meters or more. A very wide traversing angle is essential on account of the probably wide variations in the position of the enemy batteries which must be reached quickly. An 8-in. gun is best for this class of work mounted upon a carriage similar to our 8-in. barbette, model 1918, previously described.

Reprisal bombardment requires the use of long-distance guns such as the German gun which shelled Paris. This gun was not, however, mounted upon a railway carriage. A sliding type of mount, combined with a recoil mechanism, would seem to be the proper mounting.

For use against heavy concrete fortifications a howitzer such as the 16-in. would be proper, as a smaller size would probably fail to have the desired destructive effect, but for the destruction of a railway bridge the use of a 16-in. howitzer would be very wasteful, as a direct hit from an 8-in. gun would be about equally effective for destroying the superstructure.

LESSONS OF THE WAR

The value and economy of seacoast defense has been completely demonstrated in the present war. The absolute protection afforded the German coast line on the North Sea and the completely successful defense of the Dardanelles are the most striking examples. Considering the fortifications of the Dardanelles only, it is undoubtedly a fact that the coast defenses established there had a value to the Central Powers of many billions of dollars. In fact, it can hardly be contradicted that, had these fortifications been forced, the resistance of the Germans would have been broken long before was actually the case. Their military value was a hundred times their actual monetary cost. It is also probable that, had the guns at the Dardanelles been mounted on railway carriages of suitable design and had comparatively inexpensive railway tracks been laid to important tactical points, it would have been almost impossible for landing parties in any force to have succeeded in effecting their object. This lesson as to the value of seacoast defenses is of the utmost importance to us, because our coast line is so extended that the cost would be considered prohibitive if adequate, fixed fortifications were to be furnished for all points whose strategic position would apparently justify such defenses.

FIG. 5 INTERIOR OF AMMUNITION CAR

The present state of the art of artillery design is such that guns and howitzers having a range of 22,000 meters or more are of such weight and exert such forces due to the firing of the gun that they must be mounted either on fixed carriages or on railway cars. However, in the immediate future it is evident that guns mounted upon self-propelled caterpillars will appear, and probably within the next few years railway artillery will be limited to guns of 10-in. caliber and up, and howitzers of 16-in. caliber and up. The development of this caterpillar artillery was begun by the Ordnance Department about three years ago and successful types have been built for 7.5-in. guns and for 8-in. howitzers. The next step will be the substitution of the caterpillar treads for the railroad trucks in mounts such as the 8-in. gun and 12-in. mortar.

ENGINEERING SURVEY

A Review of Progress and Attainment in Mechanical Engineering and Related Fields, as Gathered from Current Technical Periodicals and Other Sources

SUBJECTS OF THIS MONTH'S ABSTRACTS

Wilson Bridge at Lyons
Bureau of Standards
Metric Manual for Soldiers
Gas Mantle Lamps, Efficiency
Recrystallization in Deformed Non-ferrous Alloys
Critical Recrystallization Temperature
Clay Firebrick at Furnace Temperature
Clay Firebrick Testing
Malleable Castings (Chills)
Casting Under Pressure
Aluminum Pistons with Low Coefficient of Expansion
Hot-Air Furnaces
Fuel-Injection Valves in Constant-Pressure Engines
Steam-Engine Lubrication
Thermodynamics of Springs
Steel Arc Welds
Smith Gas Producers
Buoyancy Boxes on S. S. "Lucia"
Wind Pressure on Tall Chimneys
Vibration of Beams of Variable Cross-Section
Ritz Method of Handling Problems of Vibration
Thickness of Wall in Tubes Under Pressure
Shell-Turning and Boring Machines, Neville Island Gun Plant
Wind for Power Generation
Economics of Turbo-Electric Stations
Heat Losses in Locomotives
Dimensions of Air Passages in Locomotive Grates
Internal Fissures in Rails
45,000-kw. Pittsburgh Steam Turbine
Low-Pressure Governors for Large Steam Turbines
Steam-Boiler Baffles
Distortion of Turbine Disks
Physical Properties of Rolled Shell Steel

BRIDGES

The Wilson Bridge at Lyons. On Bastille Day, July 14, 1918, was formally opened at Lyons Le Pont Wilson, so named in honor of the President of the United States. The Wilson bridge, as shown in Fig. 1, consists of four unequal elliptical arches with a short elliptical approach arch at each end and a total width between the parapets of about 66 ft. It is designed on the Séjourné system, which briefly consists of replacing the central portion of the arches regarded longitudinally by a deck of reinforced concrete, so that each span consists of two masonry arches entirely independent of each other, except in so far as they rest on the same abutments, with the intervening space filled in with the reinforced-concrete deck. Because of the conditions of the currents in the River Rhone the arches are not symmetrical in span about the center of the bridge.

For various reasons metallic centering instead of wooden was employed and each of the principal arches composed of three courses of masonry at the springings and two at the crown.

The voussoirs fit into each other after the manner of gear-wheel teeth, both in the longitudinal and in the transverse direction. The first course was laid down in eight sections supported on angle pieces, the sections being arranged symmetrically and in such a manner as not to cause the centering to suffer any deformation. The joints were filled with mortar rammed in by means of iron beetles. The filling was commenced at the highest joints, the succeeding joints being completed in succession at properly chosen intervals of time. (*The Engineer,* vol. 126, no. 3280, November 8, 1918, pp. 387-388, p figs., *dA*)

BUREAU OF STANDARDS

Abstract of Metric Manual for Soldiers. The aim of the metric manual is to give to American soldiers a grasp of the metric system which will enable them to think and work in metric units. As recommended, no tables of equivalents need be memorized. Brief tables and a vocabulary are given for reference. The units are described by actual examples likely to be encountered in military work. (Bureau of Standards Miscellaneous Publications No. 21)

The Influence of Quality of Gas and Other Factors Upon the Efficiency of Gas Mantle Lamps, R. S. McBride, W. A. Dunkley, E. C. Crittenden and A. H. Taylor. This paper describes the apparatus and methods employed and the results obtained in studying the effects of several variables such as gas pressure, gas adjustment, air adjustment, and gas quality upon the performance of various types of gas mantle lamps. Several tables and curves are given to assist in the presentation of the results. (Technologic Paper of the Bureau of Standards, No. 110)

ENGINEERING MATERIALS (See also Testing)

Rapid Recrystallization in Deformed Non-Ferrous Metals, D. Hanson. While the number of investigations on recrystallization phenomena in iron and steel is quite large, only two similar investigations on recrystallization in non-ferrous metals are mentioned by the author, namely, papers by Robin and by R. J. Anderson.

In the present experiments a device adopted by Chappell in his work on the recrystallization of iron (*Journal of the Iron and Steel Institute,* 1914, pt. 1, p. 460) has been used. This consists in cutting a test piece tapered toward the center, which, after it has been annealed, is broken in tension. In this way, with suitable tapering, varying degrees of deformation, from a maximum at the point of fracture to zero at a position between the fracture and the shoulder, are obtained. In order to obtain this the taper must be so regulated that under the breaking load of the test piece the material at the shoulder is not stressed beyond its elastic limit. The amount of taper which has proved suitable varied from metal to metal and has been determined by trial.

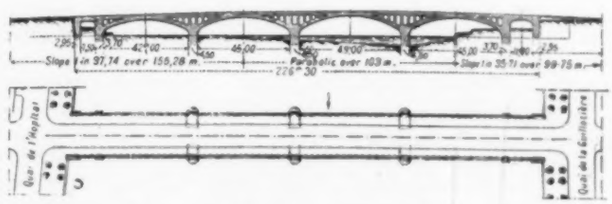


Fig. 1 Plan and Elevation of the Wilson Bridge

The paper records data secured with various metals and solid-solution alloys.

It was found in the case of aluminum and magnesium that remarkably coarse crystals had developed in the neighborhood of the shoulder where the strain was least, and that for this reason the crystal size decreased fairly regularly to the point of fracture. In the material of the shoulders which it is assumed had not been strained or in which the strain had been too slight for recrystallization to take place, the original small crystallization of the an-

nealed test piece was found, the change from coarse to fine crystals being quite abrupt.

Zinc, lead and copper exhibited essentially similar behavior. In the case of zinc, a thin sheet 0.04 in. thick was first annealed at 150 deg. cent. for half an hour, and after straining the two halves were annealed, one at 150 deg. cent. for 30 min., and the other at 300 deg. cent. for 5 min. In the case of the 150 deg. cent. annealing, recrystallization proceeded for a distance of approximately ¾ in. from the fracture; when annealed at 300 deg. cent .for only 5 min., recrystallization occurred right up to the shoulder, and the grain size which was developed was considerable. In this case, in which the times of annealing at high and low temperature are in the reverse order to those used for aluminum, the same observation was made that, speaking generally, crystals of approximately the same size were produced in corresponding positions in the test pieces, i.e., at positions of equal deformation. The only marked effect of an increase in annealing temperature had been to extend the range of recrystallization toward the less deformed end of the specimen.

Solid-solution alloys have shown phenomena essentially similar to those of pure metals. A copper-zinc-aluminum alloy has shown appreciably the same recrystallization as pure aluminum and so has 70:30 brass. The results described in this paper suggest that the following law of annealing is probably applicable to all strained metals and solid solutions:

For every degree of deformation there is a critical recrystallization temperature at which crystal growth is extremely rapid, and the size of the crystals produced by this rapid growth is the greater the smaller the amount of deformation preceding such annealing. The rate of increase in size of the newly formed crystals with prolonged time and increased temperature of annealing is small compared with their rate of growth at the critical temperature. (Paper submitted to the Institute of Metals, on November 11, 1918, abstracted through *Engineering*, vol. 106, no. 2754, October 11, 1918, pp. 403-404, 3 figs., *etA*)

THE POROSITY AND VOLUME CHANGES OF CLAY FIREBRICK AT FURNACE TEMPERATURES, Geo. A. Loomis. Paper published by permission of the Director, U. S. Bureau of Standards, and reporting an investigation undertaken in order to study the fundamental properties of clay firebricks by a comparison of their changes in porosity and volume upon heating to different temperatures with the results of a specific load test and with the so-called "softening points."

The determination of these softening points is generally considered a reliable indication of the refractoriness of the material. Actually, however, it is apt to be misleading, for bricks with the higher softening point sometimes fail to withstand practical conditions of load and temperatures; while the silicious bricks low in flux with a comparatively low softening point generally stand up well under heavy loads at fairly high temperatures. Further, the softening-point determination is misleading in the case of bricks made from a coarse mixture of very refractory non-plastic clay with an inferior bond clay.

The load tests are used by the Bureau of Standards and the ball tests first applied in the laboratories of the Carnegie Steel Company are also discussed, and the methods of carrying out the tests in the present investigation discussed. The following is a summary of the results as given by the author.

1 Brick which are capable of withstanding a pressure of 40 lb. per sq. in. at 1350 deg. cent. generally show slight changes in volume or in porosity when burned at temperatures up to 1425 deg.

2 The greater number of the brick which failed to pass the load tests show rather marked changes in volume or in porosity at some temperature below 1425 deg. cent.

3 Brick which show distinct overburning by pronounced expansion at temperatures below 1400 deg. cent. invariably fail in the load test. The adoption of a definite limit for the permissible expansion within the given temperature range is particularly important for detecting inferior clay refractories. The limit for expansion should be lower than that for allowable contraction.

4 The changes in volume and in porosity of brick burned at some temperature between 1350 deg. cent. and 1425 deg. cent. serve, in a measure, as a criterion of their ability to pass the load test.

5 Most of the brick which show a porosity decrease not exceeding 5 per cent and a volume change not exceeding 3 per cent (approximately 1 per cent in linear dimensions), when burned at 1400 deg. cent. will pass the load test.

6 Brick which show a decrease in porosity exceeding 5 per cent or an expansion of contraction in excess of 3 per cent by volume (1 per cent in length) at 1400 deg. cent. failed to pass the load test in nearly all cases.

7 The use of limiting porosity and volume changes for clay firebrick burned at 1400 deg. cent. would serve as a means of eliminating from consideration a large number of brick which fail in the load tests.

8 Brick which fail in the load test—due to failure in the bond—may not show marked changes in volume or porosity in burning but often show very low cold-crushing strength.

9 No definite relationship seems to exist between the softening point of a firebrick and its ability to withstand load at high temperatures. However, all brick which softened below cone 28, whether silicious in character or not, failed completely in the load test. It seems advisable, then, to specify cone 28 as the minimum softening point for any clay firebrick. It is probable that brick containing less than 65 per cent SiO_2 should have a minimum softening point of cone 31. (*Journal of the American Ceramic Society*, vol. 1, no. 6, June 1918, pp. 384-404, 2 figs., *eA*)

FOUNDRY

THE INTEGRITY OF THE MALLEABLE CASTING, Enrique Toucede. The writer claims that without present knowledge of the art of malleable casting, it is possible to produce regularly such a character of hard iron that when annealed it will yield metal of superior strength and ductility. If failure occurred, it was because the foundryman did not make sure at all times that castings were invariably sound throughout.

In proof of this, the writer offers figures showing the combined monthly average ultimate strength and elongation of some 32 different companies for a period of three months based on data from many hundreds of tests. These figures show a remarkable uniformity of the average values over that period.

It is claimed that lack of solidity, when it occurs, is mainly due to failure on the part of the founder to recognize the fact that in castings of disproportionate sections so frequently used in malleable-iron work the thinner sections solidifying more quickly than thicker ones would draw the metal from the still fluid parts before they, in turn, were able to secure their full share of metal from the risers.

The use of chills was tried to equalize cooling and while it did not always do it sufficiently to make heavy parts perfectly sound, it did serve to lessen the shrink and drive it from a place where its presence was fatal to a locality much less harmful. Nevertheless, the writer considers that the use of chills has been harmful as it kept the founder from discovering the real cure for this trouble. (Paper presented at the American Foundrymen's Convention, at Milwaukee, October 7-11, 1918, abstracted through *The Iron Age*, vol. 102, no. 20, November 14, 1918, pp. 1204-1205, *p*)

CASTING UNDER PRESSURE. Description of a new process for forming castings of non-ferrous alloys. This process consists in pouring the molten alloys into metal molds and forming or congealing the castings under pressure. The castings are made in a specially constructed automatic machine by which several hundred are turned out per hour. The alloys used so far have been one of 60 per cent copper, 40 per cent zinc, with a trace of lead, and another alloy of 86.5 per cent aluminum, 12 per cent zinc, 1.5 per cent copper. A large number of fuse bodies for shrapnel have also been produced of an alloy of 80 per cent aluminum and 20 per cent zinc made to British specifications which call for an elongation of 7 per cent in 2 in. Tests have shown that this alloy actually possesses an elongation in excess of 14 per cent in 2 in. with a tensile strength of 41,440 lb. per sq. in. and an elastic limit of 30,400 lb.

In this process an alloy has been made and used consisting of aluminum, copper and iron with a low coefficient of expansion. The introduction of iron into this alloy promises to make it possible to produce very large aluminum pistons for high-power aircraft engines without running into the usual difficulties caused by the high coefficient of expansion of aluminum.

A similar alloy appears to have been used in the framework of a German Zeppelin machine. (*The Iron Age*, vol. 102, no. 19, November 7, 1918, p. 1138, *d*)

FUELS AND FIRING

SAVING COAL IN BOILER PLANTS, Henry Kreisinger, Mem.Am. Soc.M.E. A paper containing suggestions as to what can be done in the boiler room to save coal and intended especially for medium-size plants, which, as a rule, have less efficient equipment and management than large and modern plants. The paper is of particular interest, but is not suitable for abstracting. (*U. S. Bureau of Mines Technical Paper* 205, *p*)

HEATING AND VENTILATION

HOW TO IMPROVE THE HOT-AIR FURNACE is the title of Technical Paper 208, just issued by the Bureau of Mines, Department of the Interior, the author being Charles Whiting Baker.

O. P. Hood, chief mechanical engineer of the bureau, in reviewing Mr. Baker's paper, says: "Hot-air furnaces for house heating are used in such great numbers, especially the smaller sizes, that one would expect a considerable literature on the subject of

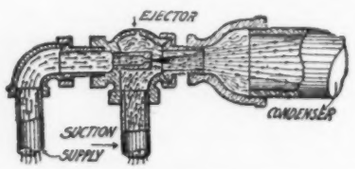


FIG. 2 STEAM EJECTOR USED IN THE MOLINE VACUUM VAPOR HEATING SYSTEM

their economical design, installation, and operation. As a matter of fact, there is much less to be found on this subject than on steam and hot-water house-heating equipment, largely because of the difficulty of measuring the output from a hot-air furnace. The quantity of heat absorbed from the fire by either hot-water or steam systems is rather easily measured by accepted methods, but it has proved a problem of some difficulty to accurately measure the quantity of heat absorbed by the hot-air furnace. Hence the problem has been much less attractive as a laboratory investigation than problems having to do with steam or hot-water apparatus. There is, however, a real need for a larger body of information about the performance of hot-air furnace installations than is now available.

"Mr. Baker's article shows how interesting such problems can be, how really worth while it is for a good engineer to give them careful and ingenious attention. The Bureau of Mines is glad to print such material, which will not only help many users of hot-air furnaces but will also tend to stimulate investigation in this fertile field.

"During the war the husbanding of fuel supplies must be a matter of vital concern to the country. The Bureau of Mines, in its efforts to bring about greater efficiency in the use of fuels, has paid much attention to the improvement of house-heating and boiler-plant equipment and methods of operating them, and has published a number of reports on the subject. Among these are Technical Paper 80, Hand-Firing Soft Coal under Power-Plant Boilers; Technical Paper 97, Saving Coal in Heating Houses; Technical Paper 199, Five Ways of Saving Coal in Heating Houses; and Technical Paper 205, Saving Coal in Boiler Plants.

"This paper, which was presented by the author before the American Society of Heating and Ventilating Engineers, at Buffalo, N. Y., in June, 1918, points out certain defects in existing types of hot-air heating plants, and suggests a number of improvements in construction and operation that will add to the comfort of the householder and lessen his coal bills. Moreover, the paper deals with a subject that, in spite of its wide interest, has received relatively little attention and is not treated in any other publication of this bureau. For these reasons, and for the further reason that general observation of the suggestions would effect an important saving in fuel, the paper is published by the Bureau of Mines."

Copies of this paper may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

MOLINE SYSTEM OF VACUUM VAPOR HEATING. This system belongs to the class of those in which the steam pressure ordinarily carried is practically at atmosphere or slightly below, or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns. It is characterized by the use of a lock-shield globe valve on the return end of each radiator and the use of an ejector fitting to produce a pull on the return lines of greater intensity than can be secured by simply opening the return line to the atmosphere, or by connecting the air-vent line to the chimney and employing the chimney draft.

The steam ejector, which is the main characteristic feature of the system, is operated by the steam or air pressure at the end of the supply main, just before it drops down to enter the boiler return.

Fig. 2 shows how the steam or air under pressure in the steam line flows out through the nozzle of the ejector fitting, creating, by its velocity, a section around the jet, and employing this section to draw the air from the return lines to discharge the mixture into the condenser.

The article describes also the air trap used with this system. (*Heating and Ventilating Magazine*, vol. 15, no. 11, November 1918, sixth installment of a serial article, pp. 44-46, 5 figs., *d*)

INTERNAL-COMBUSTION ENGINEERING

Fuel-Injection Valves for Diesel Engines

FUEL-INJECTION VALVES IN CONSTANT-PRESSURE ENGINES, W. Stremme. Data for the calculation of needles and springs in needle valves for engines of the constant-pressure type. According to Fig. 3, the injection air which atomizes and injects the fuel enters through the atomizing chamber R. In the circular cross-section of this chamber the air acquires a certain velocity. Further, the dimensions of this air-injection chamber determine the amount of air available for the fuel injection at the instant of opening of the valve orifice. In the same chamber R are located the atomizing disks P, and the size and number of orifices in these disks determine the velocity of the air available for its intermixing with the fuel. Each atomizing disk measures the velocity of flow of the fuel-air mixture, and the more disks there are in the chamber R, the slower does the injection occur. No improvement in fuel injection can be secured by any very large increase in the number of atomizing disks.

The atomizing disks are followed by the atomizing cone, the purpose of which is likewise to give the fuel-air mixture a certain velocity of flow. The cone K regulates the valve opening and closing. The nozzle orifice S must also have a certain cross-section, since it is here that the atomization of the fuel properly takes place. All the cross-sections in the path of the flow of air inside of the fuel valve must be several times greater than the section of the nozzle. In Fig. 4, *ad* shows the developed cam governing the fuel-valve motion. This line *ad* likewise determines the duration of opening of the fuel valve. During the opening of the valve, throttling occurs over *ab*, due to the action of the cone on the needle; it also occurs over *cd* during the closing of the valve.

From point *b* on, the cross-sections opened up by the needle are larger than the nozzle cross-sections, and hence the curvature of the cam determined by the height h_1 has no influence on the variation of the fuel flow. An increase in the nozzle opening

displaces the point b toward b_1 and the point c toward c_1. Therefore, the amount of injection air can be increased by using a steeper shape of the cam, ab_2 and c_2d, and can be reduced by giving the cam a gentler slope, as ab_3 and c_3d. The amount of injection air may also be increased with the same cam shape by increasing the size of the holes in the atomizing disks, and contrariwise, may be reduced by reducing their size. The variation of the nozzle orifice has the greatest influence on the amount of injected air.

However, the rate of air injection can also be effectively varied

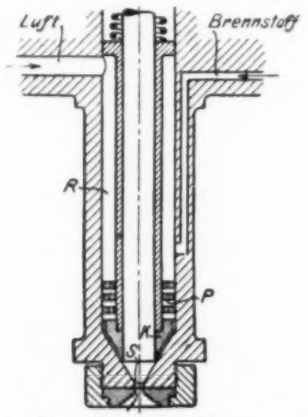


FIG. 3 DIAGRAM OF FUEL-INJECTION VALVE IN A CONSTANT-PRESSURE-TYPE ENGINE

(*Luft*, Air; *Brennstoff*, Fuel)

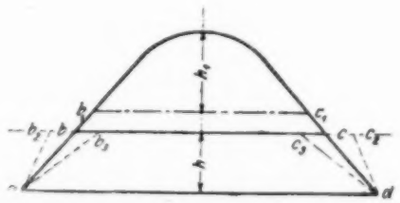


FIG. 4 DEVELOPED PROJECTION OF A CAM FOR THE VALVE SHOWN IN FIG. 3

by changing the injection pressure. The amount of air Q flowing through the nozzle is determined by the equation $Q = fv$, where f is the cross-section of the nozzle and v the velocity of the flow of air. This velocity of flow of air can be calculated from the following formula:

$$v = \sqrt{\frac{2gH}{\gamma}} = K\sqrt{H}$$

where H is the gage pressure of the injection air.

This method is used for reducing the output of stationary and marine engines in order to secure a combustion free of carbon deposits through a reduction of the injection air pressure.

If in the last equation the magnitude of $\sqrt{H}$ remains unaltered, the equation $f = Q/v$ can also be written in the form $f = cQ$. Q is here the amount of the fuel-air mixture which passes per unit of time through the cross-section f. In order to produce a good atomization of a given amount of fuel, q, it is necessary to apply a certain definite amount of injected air. Hence, Q = Fuel + Air of Injection, or $Q = q + mq = q\,(1 + m)$, and the equation $F = cQ$ becomes $F = c\,(1 + m)\,q = c_1q$. For a nozzle cross-section δ we have the equation $\delta = K_0\sqrt{q}$. Instead of the fuel consumption per second, we may use the engine output N_i. This alters the coefficient in the above equation, which becomes $\delta = K\sqrt{N_i}$.

Since the value of K is affected by many independent variables, it is impossible to give it a numerical value which would be good for all cases. Rather the exact value of K should be determined for each engine. The standardization of the fuel nozzle can be carried out only in so far as to determine for each engine the dimensions of the fuel nozzle, which, in as far as possible, corresponds in every respect to the performances desired. The value of K can be determined from the equation $\delta = K\sqrt{N_i}$. The knowledge of the value of K permits to determine the characteristics of the nozzle for engines of the same type, and this again determines the dimensions of all other parts. Fig. 5 shows the relations of the values based on the above described standardization, with reference, however, to existing engine types.

The abscissæ of Fig. 5 show the outputs of individual cylinders, and the ordinates, the values of cross-sections of the main atomizing devices referred to the nozzle cross-sections, calculated from the above formula. Curve I is the curve of the valve space. Curve II gives the relative values of the needle cross-section and Curve III the values of the cross-sections of the holes of the atomizing plates. The cross-sections of the cone passages are also roughly taken into consideration. Curve IV gives the values of the sections of the passages of the needle cone.

Engines which have been built according to such standardized proceedings need not, in the opinion of the writer, be tested out at the factory. Besides, such a standard proceeding gives at once the main dimensions of the fuel valve for engines to be built. (Original article published in *Zeitschrift des Vereines deutscher*

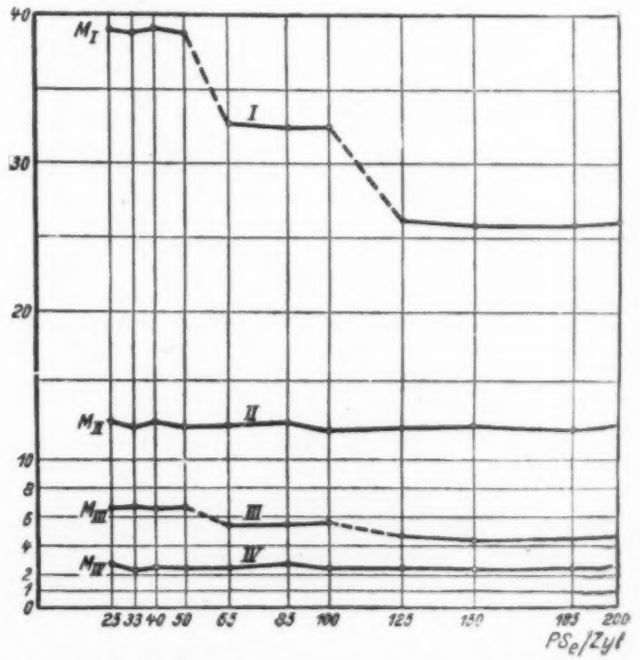


FIG. 5 RELATIVE VALUES OF CROSS-SECTIONS IN THE PATH OF AIR FLOW IN VALVE OF THE TYPE SHOWN IN FIG. 3

($PS_e/Zyl.$, Hp. per Cylinder)

Ingenieure, 1918, pp. 111 and following; abstracted through *Dingler's polytechnisches Journal*, vol. 333, no. 10, May 18, 1918, pp. 85-86, 3 figs., *p*)

LUBRICATION

Oil Consumption in Steam-Engine Lubrication

STEAM-ENGINE LUBRICATION, Hilliger. According to Schmid, in steam engines properly cared for the hourly consumption of cylinder oil in grams may be taken to be equal to $L = 1.6D_n sn$, where D_n is the diameter of the low-pressure cylinder in meters, s the stroke in meters and n the speed in r.p.m. Weiss offered for the same case the equation $L = 2D_h n$, where D_h is the diameter of the high-pressure cylinder. If the two equations were correct they should have given approximately equal values for similar engines. Table 1, however, which gives the oil consumption per hour calculated for several engines in accordance with both of these equations, shows that the values thus obtained do not agree very well with each other. Apparently, the equations cited above do not give the correct minimum values of oil consumption.

Hilliger has carried out tests with a view to determining the oil consumption of a steam engine. These tests were made on a locomobile built by the Wolf Company of Magdeburg. The cylinders were lubricated by a pressure pump which delivered 12 grams of oil per hour to the cylinders at 230 r.p.m. of the engine. The cylinders were 130 mm. (5.1 in.) bore and 260 mm. (10.2 in.) stroke. In each test the cylinder received a definite amount of oil. The lubrication was then stopped and the variation of mechanical efficiency with time determined. In order to establish accurately the quality of the cylinder lubrication it was necessary to determine the mechanical efficiency with precision. For the determination of the effective output of the locomobile, a load was used consisting of a belt-driven direct-current generator.

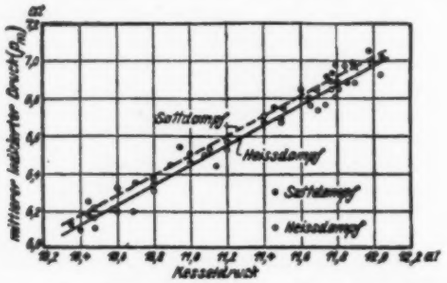


FIG. 6 RELATION BETWEEN AVERAGE INDICATED PRESSURE AND BOILER PRESSURE FOR SUPERHEATED AND SATURATED STEAM

(Ordinates: Average indicated pressure (p_m); abscissae: Boiler pressure; *Sattdampf*, Saturated steam; *Heissdampf*, Superheated steam; *at*, pressure in atmospheres.)

The indicated output of the engine was determined from the equation $N_i = 0.015 p_m n$, where p_m is the average indicated pressure in atmospheres. In the course of the tests it was found impossible to determine p_m from the indicator diagrams with sufficient precision. Because of this the governor was so adjusted that up to a speed of 245 r.p.m. it could not affect the valve gear. By plotting diagrams of equal cut-off but with variable admission pressure, it can be shown that the average indicated pressure varies approximately with the boiler pressure. Since the expansion line of superheated steam is different from that of saturated steam, the relation between the average indicated pressure and the boiler pressure has to be determined separately for the two conditions of steam, and Fig. 6 shows this relation for both cases.

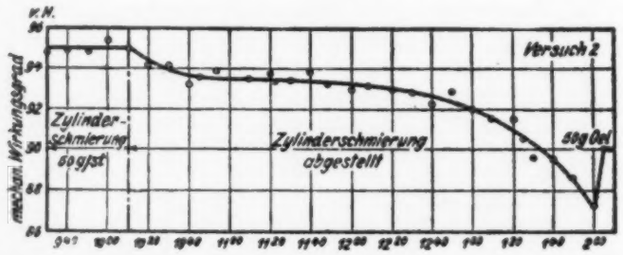


FIG. 7 VARIATION OF MECHANICAL EFFICIENCY WITH VARIATION OF SUPPLY OF OIL WITH SATURATED STEAM

(Ordinates: Mechanical efficiency, per cent; Abscissae: Time; *Zylinderschmierung 50 g/St*, Cylinder lubrication 50 grams per hour; *Zylinderschmierung abgestellt*, Oil feed to cylinder discontinued; *Versuch 2*, Test No. 2; *50 g Oel*, 50 grams of oil supplied to cylinder.)

TABLE 1 CYLINDER-OIL CONSUMPTION OF STEAM ENGINES

Cylinder diameter, mm.	Stroke, mm.	R.p.m.	Cylinder-oil consumption in grams per hour calculated according to	
			Schmid	Weiss
680 and 1000	1200	80	153	109
475 and 740	900	103	109	98
320 and 500	470	109	40	68
200	360	120	14	48

In the tests with the boiler pressure maintained at the same level of 11.8 atmos., the electrical output was so manipulated that in all tests the speed of rotation was 230 r.p.m. In this way the indicated output was maintained the same in all tests and the effective output can then be calculated from the equation—

$$N_e = \frac{\text{voltage} \times \text{current}}{736 \eta_{el} \eta_R}$$

where η_{el} is the electrical efficiency of the generator and η_i^R the efficiency of the belt drive, which latter may be taken to be equal to 0.95. The mechanical efficiency is then $\eta_{mech} = \frac{N_e}{N_i}$. The three types of oil which were used with tests, with their respective characteristics, are described in Table 2.

Fig. 7 graphically represents the data of tests with the German superheated-steam oil used with saturated steam. With regular lubrication the curve of efficiency runs about 95 per cent. With the supply of oil discontinued, the curve stays for a while at 95 per cent and then begins to fall off rapidly. When the efficiency has fallen five or six per cent, 50 grams (1.75 oz.) of oil are forced into the cylinder, which produces a considerable improvement in mechanical efficiency.

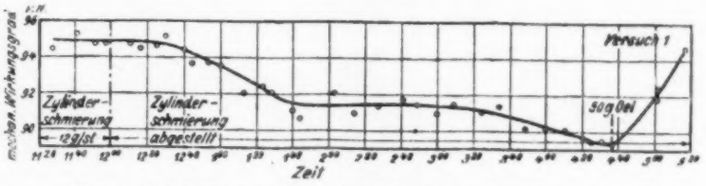


FIG. 8 VARIATION OF MECHANICAL EFFICIENCY WITH VARIATION OF SUPPLY OF OIL WITH SUPERHEATED STEAM

(Ordinates, Mechanical efficiency, per cent; abscissae, Time; *Zylinderschmierung 12 g/St*, Cylinder lubrication 12 grams per hour; *Zylinderschmierung abgestellt*, oil feed to cylinder discontinued; *Versuch 1*, Test No. 1; *50 g Oel*, 50 grams of oil supplied to cylinder.)

In tests with superheated steam the same German superheated-steam oil was used. In these tests also the efficiency did not vary during the time that oil was regularly fed to the cylinders, but fell off very soon after the supply of it was discontinued, even though at a rate not as rapid as in the case of saturated steam. Fig. 8 represents graphically the data of these tests. In order to secure a clearer insight into what has taken place with cylinder lubrication, it was necessary also to determine the minimum amount of oil with which the engine could be uniformly operated. This may be defined as the amount of oil with which the mechanical efficiency will be maintained at its highest point. Fig. 9 shows

TABLE 2 TYPES OF CYLINDER-OIL USED IN HILLIGER'S TESTS

Types of cylinder oil	Specific weight, kg. per liter	Flashpoint, deg. cent.	Engler viscosity at 100 deg. cent.	Freezing point, deg. cent.
American superheated steam....	0.900	300	4.5	0
German superheated steam....	0.955	270	3.5	25
German.....	0.965	235	6.5	10

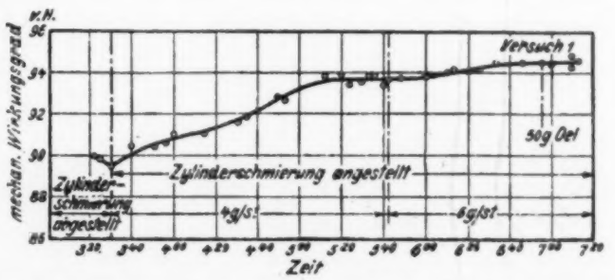


FIG. 9 EFFICEINCY CURVE WITH VARIABLE OIL FEED, SUPERHEATED STEAM

(Ordinates: Mechanical efficiency per cent; Abscissae: Time; *Zylinderschmierung abgestellt*, Oil feed to cylinder discontinued; *Zylinderschmierung angestellt*, Cylinder lubrication resumed; *g/St*, grams per hour; *Versuch 1*, Test No. 1; *50 g Oel*, 50 grams of oil supplied to cylinder.)

the plot of the efficiency curve with variable oil feed. The reciprocal values of the amount of oil necessary to maintain efficient lubrication may be considered as index figures for the given oil.

Fig. 10 shows the manner in which the specific oil consumption varies with the indicated output. The values of oil consumption have been derived from marine engines of similar construction in which the oil consumption has been carefully noted. From this figure it appears that with increase in output the specific oil consumption decreases very materially, but at high outputs there is no longer any noticeable decrease in oil consumption. In the foregoing figures the oil used in lubricating the auxiliary engines,

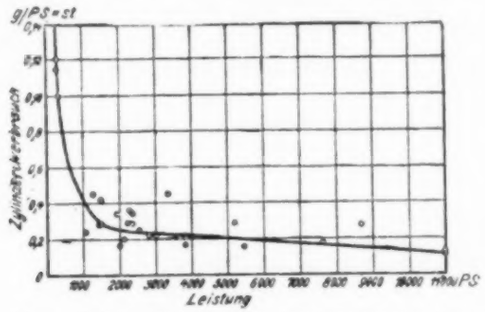


FIG. 10 VARIATION OF SPECIFIC OIL CONSUMPTION WITH INDICATED OUTPUT, MARINE ENGINES.

(Ordinates: Oil Consumption per Cylinder, in Grams per Hp-Hour; Abscissae: Cylinder Output in Hp.)

amounting to from 8 to 10 per cent of the total consumption, has also been taken into consideration.

Stationary engines of the vertical type show a higher oil consumption than marine engines. The straight-flow engines, of which quite a number have been built in recent years, show, in general, a peculiar behavior, in that the specific oil consumption decreases with the increase of output along an approximately straight-line law. At the same time, as is evident from Fig. 11, they have a very

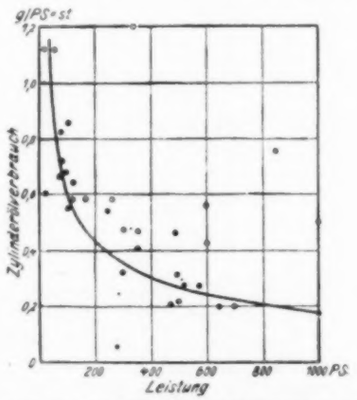


FIG. 11 VARIATION OF SPECIFIC OIL CONSUMPTION WITH INDICATED OUTPUT OF VARIOUS TYPES OF STEAM ENGINES

(Ordinates: Oil Consumption per Cylinder in Grams per Hp-Hour; Abscissae: Cylinder Output in Hp.)

high general oil consumption, due, apparently, to the large piston surface, and to the arrangement of exhaust slots. The piston in passing over the exhaust slots scatters through them a certain amount of lubricating oil which is in this way lost for further lubrication.

For horizontal stationary engines the law governing oil consumption is difficult to establish because of the variety of types of such engines. Fig. 12 gives an idea as to the values of consumption found with this type of engine. These figures give the total oil consumption; that is, in addition to the cylinder lubrication, also that used for the lubrication of the stuffing boxes on the piston rods, valve rods and connecting rods.

Finally, Fig. 13 gives a résumé of the cylinder-oil consumptions of various types of steam engines. (*Zeitschrift des Vereines deutscher Ingenieure*, 1918, Nos. 14, 15, 16, abstracted through *Dingler's polytechnisches Journal*, vol. 333, no. 14, July 13, 1918, pp. 122-124, 8 figs., *e*)

MACHINE DESIGN

ON THE THERMODYNAMICS OF SPRINGS, H. Bock (*Zeits. Instrumentenk.* 38. pp. 109-115, July, 1918). The thermal processes which ensue during the extension of elastic bodies have long been known, but although of outstanding significance for engineers, yet the data have been seldom employed by them, probably owing to the form in which they have usually been expressed. The author now attempts by means of an analogy with the p-v diagram to give a simple process whose application to the theory of springs leads to the possibility of expressing numerically the

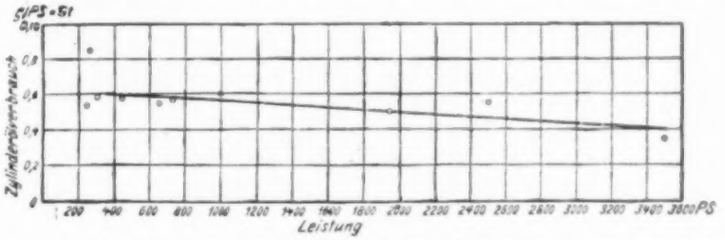


FIG. 12 VARIATION OF SPECIFIC OIL CONSUMPTION WITH INDICATED OUTPUT, HORIZONTAL STATIONARY ENGINES.

(Ordinates: Oil Consumption per Cylinder in Grams per Hp-Hour; Abscissae: Cylinder Output in Hp.)

elastic after-effect. It is shown that perfectly elastic bodies must be attended by such after-effects—a fact of considerable importance for fine springs such as chronometer spirals. The various limitations assumed are first given, and then the equation of state of a long bar is derived corresponding to that for a gas. The σ-l diagram is next plotted, where l is the length and σ the tension along this direction. Following this comes a discussion of the internal energy of the bar, together with the determination of c_l (the specific heat at constant length corresponding to that of constant volume in the gas equation). The adiabatics of the bar is next examined, and the expression for the entropy obtained. The theoretical results are then applied to determine the energy loss when the bar is made into a spring, and the special case of energy loss in the watch spring concludes the paper. (*Science Abstracts*, Section A—Physics, vol. 21, pt. 10, no. 250, October 31, 1918, p. 436, *t*)

MACHINE SHOP

INSPECTION OF STEEL ARC WELDS, O. S. Escholz. It is stated that the four factors which determine the physical characteristics of the metallic-electrode arc welds are fusion, slag content, porosity and crystal structure.

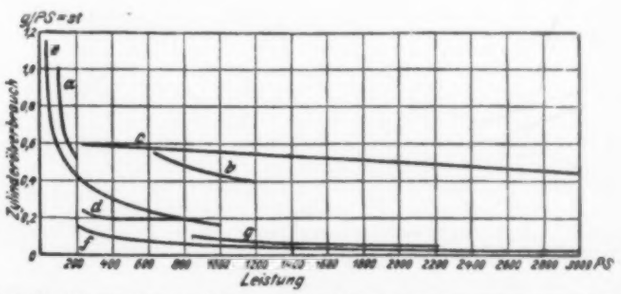


FIG. 13 VARIATION OF CYLINDER-OIL CONSUMPTION WITH INDICATED OUTPUT, STRAIGHT-FLOW ENGINES

(Ordinates: Oil Consumption per Cylinder in Grams per Hp-Hour; Abscissae: Cylinder Output in Hp.)

The writer enumerates various methods for determining the quality of the weld. The most reliable indication of the soundness of the weld is offered by the penetration tests. In the testing of small samples excellent results are made possible by the use

of X-rays, but it is difficult to manipulate with the present apparatus in large-scale production.

In penetration tests, liquids, such as kerosene, give practically as good results as gases and are much easier to apply. Because of its low volatility and high-surface tension, kerosene sprayed on a welded surface is rapidly drawn into any capillaries produced by incomplete fusion between deposited metal and weld scarf or between succeeding deposits, slag inclusions, etc. It penetrates through the weld and shows the existence of a weak structure by a stain on the emerging side.

Electric test methods by which the homogeneity of welds is determined are still in the evolutionary stages. The tests recommended are visual examination, chipping and penetration tests.

As regards the arc weld itself, the cardinal steps in its analysis are preparation of weld, electrode selection, arc-current adjustment, arc-length maintenance and heat treatment.

In this connection the writer points out that a great many companies have attempted welding with too low an arc current and the result has been a poorly fused deposit. This is due

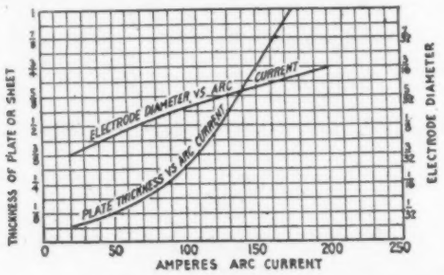


FIG. 14 VALUES OF ARC CURRENT TO BE USED FOR A GIVEN THICKNESS OF STEEL PLATE AND OF ELECTRODE DIAMETER FOR A GIVEN ARC CURRENT

largely to the overheating characteristics of most electrode holders which lead the operator to believe that the current used is in excess of the amount needed.

The approximate values of arc current to be used for a given thickness of mild-steel plate, as well as the electrode diameter for a given arc current, may be taken from the curves of Fig. 14. The variation in the strength of 1-in.-sq. welded joints as the welding current is increased is shown in Fig. 15.

In the opinion of the writer the heat treatment of a completed weld is not a necessity particularly if it has been preheated for

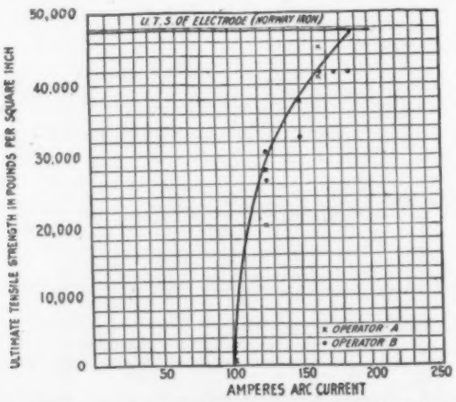


FIG. 15 VARIATION IN THE STRENGTH OF A ONE-INCH-SQUARE WELDED JOINT WITH VARIATION IN THE WELDING CURRENT

preparation and then subjected to partial annealing. A uniform annealing of the structure is desirable even in the welding of the small sections of alloy and high-carbon steels, if it is to be machined or subjected to heavy vibratory stresses. (*Iron Age*, vol. 102, no. 23, December 5, 1918, pp. 1390-1391, 2 figs., *p*)

MACHINE SHOP FOR GAS-PRODUCER WORK. Description of the new plant and gas producer of the Smith Gas Engineering Company at Morain City, a suburb of Dayton, Ohio.

The design of the generator is such that the heavy elements (shell and lining) are stationary, freeing the operating mechanism from severe strains. Grates and clinker bars operate through compressed-air cylinders. Coal is charged without admission of air, the stokers being driven by a variable-speed electric motor and each capable of independent starting or stopping by engagement or disengagement of its driving pawl.

The gas from the generator goes through a downcomer to a primary cooler, then to a gas pump and tar extractor. The tar-laden gas in passing through the extractor comes in contact with the diaphragm of spun glass. Friction against this material charges it with static electricity, which causes fine particles in the tar fog to cling together until they are of sufficient size to drop out of the current by gravity. This spun glass, by the way, had to be imported from Austria before the war, but is now produced in this country. (*Iron Age*, vol. 102, no. 23, December 5, 1918, pp. 1373-1378, 14 figs., *d*)

MARINE ENGINEERING

APPLICATION OF BUOYANCY BOXES TO THE S. S. "LUCIA" FOR THE U. S. SHIPPING BOARD, W. T. Donnelly, Mem.Am.Soc.M.E. Brief description of a method for providing internal buoyancy for ships or boats, with numerous plates illustrating the construction used on the S. S. *Lucia*.

At an early stage in the work it was found that ordinary methods of construction for the buoyancy boxes would not do and new ways of construction had to be developed to make the boxes capable of withstanding pressure and absolutely watertight. Every box was tested by air pressure and floated in a tank before being placed in the vessel.

Approximately 12,000 boxes, divided about equally between buoyancy boxes for ship, or cargo, were required. As regards the question of reduction of cargo space due to the presence of the boxes, it is claimed that this reduction corresponds only to the weight of the buoyancy boxes and has no necessary bearing upon the room they occupy.

The paper presents in considerable detail the buoyancy and stability calculations for the S. S. *Lucia*, together with calculations as to what would happen in case of various parts of the ship being opened by a torpedo explosion. In considering the problems of longitudinal stability, the writer uses the section-modulus method instead of the metacentric-height method such as was first employed by Professor Hovgaard, and the difference between these two is carefully pointed out.

From the mechanical engineer's point of view the details of flotation boxes are, of course, of considerable interest. Because of this Fig. 16 is reproduced giving the details of three types of boxes found necessary.

The boxes have been so standardized that a uniform size of lumber can be used for all types. The boxes actually used were made of ordinary lumber and galvanized sheet iron and the quantity of the latter was quite considerable. (Paper before the Society of Naval Architects and Marine Engineers, read at the Annual Meeting, in Philadelphia, November 14-15, 1918, 14 pp. and 10 plates of drawings, abstracted from advance copy, *dA*)

MECHANICS

Vibration of Tall Chimneys

WIND PRESSURE ON TALL CHIMNEYS. Data of an investigation by Professor Omori (Japan) on the movements which wind pressure induces in the top of a tall chimney. The interest of this investigation lies in the fact that it furnishes the means of determining the degree of stability possessed by tall columns having an oscillation period of more than two seconds.

The chimney was erected at Saganoseki by the Weber Chimney Company of Chicago and is made of reinforced concrete. Its height is 550 ft. above the foundation pier. It stands on a hard paleozoic formation of a very low seismic movement. The base is about 450 ft. above sea level, which brings the top to a height of about 1000 ft. where it must experience a much greater wind velocity than that registered at the surface. The external diameter

is 27 ft. 5 in. at the top and 42 ft. 8 in. at the bottom. The wall thickness is 7 in. at the top and 29.5 in. at the bottom.

The article describes the method of observation used. The oscillations of the top of the shaft as registered by the automatic recorder are reproduced on a much reduced scale in Fig. 17. The upper diagram shows the motion transverse to the direction of the wind at the time of greatest velocity during a storm (December 26) when a Robinson anemometer recorded a wind velocity of 35 meters per second (114.8 ft. per sec.). The lower curve indicates the motion parallel to the direction of wind about one-half hour later. The difference in amplitude is very pronounced. The observers on the top of the column were sensible of the greater oscillation in the direction of the component at right angles to the wind's direction than that parallel to the wind. Professor Omori attributes this peculiar behavior to the pressure of the wind bending the column and rendering it more difficult for it to oscillate. The writer remarks, in this connection, that since the angle through which the column is bent (supposing it to move as one piece) is only about 30 seconds of arc, a greater variation in the time of vibration could be expected than is shown in the diagram if this damping action of the wind were real. But the constancy of periods in winds of all strengths is as remarkable as the variation in amplitudes.

Table 3 and Table 4 show the vibrations of the column in directions normal and parallel to that of the wind. One of the important facts indicated by these figures is the rapid increase in amplitude with the increase of the wind's velocity. It appears that the simple law according to which pressure varies as the square of the velocity does not hold here at all. The period of oscillation in either direction does not vary with the amplitude, at least within the range of the present experiment. The mean period of the transverse oscillation is very slightly larger than that of the parallel, and if this difference be real it may be traceable to the position of the flue causing the shaft to oscillate more easily in the transversal direction, but the evidence is not conclusive.

The diagram of Fig. 17 shows a succession of small and large vibrations at intervals of about 10 or 12 sec., the maximum motion never being continuous for any considerable length of time. In this respect the column behaved as a huge anemometer and the duration of alternating large and small groups of vibrations may be regarded as indicating a comparatively rhythmical succession of periods of violent winds alternating with the times of cessation.

The article presents briefly data of similar observations on two other chimneys in Japan, each having a height of 100 ft.

The main conclusion reached is that wind pressure on a tall chimney can entail consequences as disastrous as those due to seismic motions, even in countries where such occurrences are frequent and severe. The observed motion of the Saganoseki chimney indicated a maximum acceleration of 565 mm. per sec. per sec., whereas on the occasion of the destructive Tokio earthquake of June 20, 1894, the intensity was 444 mm. per sec. per sec. Should the wind velocity reach 50 meters (164 ft.) per sec. the vibration would acquire an acceleration of more than 1000 mm. per sec. per sec. Only very near the epicenter of an earthquake is such an intensity to be anticipated. Again, a reinforced-concrete chimney of less than 200 ft. in height must be regarded as a "short column," and in such structures it is desirable to reduce the height of the center of gravity as much as possible. On the other hand, the 550-ft. Saganoseki chimney, and still more a 1000-ft. chimney already projected, must be regarded as "tall columns" that are seismically weakest, not at the base, but at

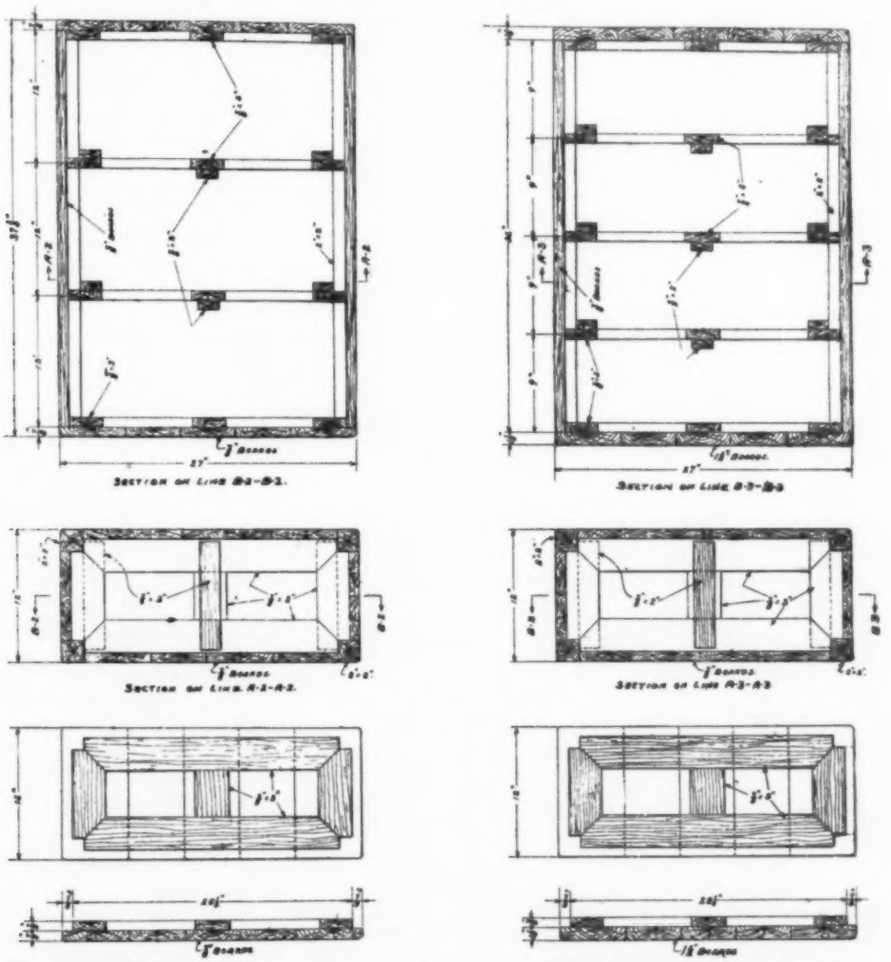


FIG. 16 DETAILS OF FLOTATION BOXES USED IN THE DONNELLY METHOD OF INCREASING BUOYANCY OF SHIPS

about two-thirds of the height. In the usual chimney construction the center of gravity of the whole structure is situated at about one-third of the height, while that of the upper third portion alone is nearly at the middle of its height, causing the shaft to be comparatively weak near the top. Professor Omori recommends such a distribution of the material that the center of gravity should be at one-fourth the height of the whole structure, as well as for the upper portion alone. In such a case the chimney would possess uniform strength against an earthquake shock. But if the center of gravity of the upper third part be about the middle of this section, the effect would be to weaken the shaft at the place where the seismic motion would be most effective. (*Engineering*, vol. 106, no. 2752, September 27, 1918, pp. 334-336, 8 figs., *eA*)

TABLE 3 VIBRATION OF COLUMN NORMAL TO THE DIRECTION OF WIND

Date and hour, 1916	Wind velocity, m. per sec.	Range of motion, mm.	Complete period, sec.
Dec. 23, 9.00 a.m.	6.9	0.18	2.55
	6.7	0.13	2.58
	5.5	0.17	2.55
Dec. 23, 2.15 p.m.	4.5	0.14	2.54
Dec. 24, 2.30 p.m.	1.0	0.13	2.53
Dec. 24, 10.00 a.m.	4.5	0.46	2.56
Dec. 25, 11.00 a.m.	1.8	0.72	2.54
Dec. 26, 3.00 p.m.	35.0	186.00	2.56

TABLE 4 VIBRATION OF COLUMN PARALLEL TO THE DIRECTION OF WIND

Date and hour, 1916	Wind velocity, m. per sec.	Range of motion, mm.	Complete period, sec.
Dec. 22, 3.30 p.m.	22.0	20.00	2.56
Dec. 24, 1.00 p.m.	1.0	0.47	2.52
Dec. 24, 11.00 a.m.	1.0	0.24	2.53
Dec. 26, 3.30 p.m.	35.0	20.00	2.54

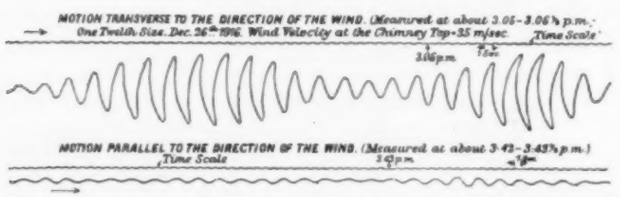

MOTION TRANSVERSE TO THE DIRECTION OF THE WIND. (Measured at about 3.05–3.06½ p.m.)
One Twelfth Size. Dec. 26th 1916. Wind Velocity at the Chimney Top=35 m/sec. Time Scale
3.06 p.m.
MOTION PARALLEL TO THE DIRECTION OF THE WIND. (Measured at about 3.42–3.43½ p.m.)
Time Scale
3.43 p.m.

FIG. 17 MOTION OF A TALL CHIMNEY TRANSVERSE (TOP) AND PARALLEL (BOTTOM) TO THE DIRECTION OF THE WIND

ON VIBRATIONS OF BEAMS OF VARIABLE CROSS-SECTION, N. W. Akimoff, Mem.Am.Soc.M.E. The paper presents a review of the fundamental investigations of the best-known problems of vibratory motion of rods and proposes to revive the interest of research engineers in the method of Ritz, published about ten years ago, but comparatively unknown in many engineering circles.

The paper is mainly of a mathematical character and as such is not suitable for abstracting. The writer considers the method proposed for finding periods of vibrating bars by Professor Morrow. The principle of this method is as follows: By assuming an equation which completely satisfies the end conditions, both the vibration curve and the period of the fundamental oscillation are found to any required degree of accuracy. This method is especially valuable in finding the periods of vibration when the density and flexural rigidity of the bar are variable from point to point in its length. The author applies the Morrow method to the consideration of the cases of a clamped-free bar, free-free bar and various cases of clamped-free bars of variable breadth and depth.

From this the author proceeds to a brief reference to Professor Slocum's formula for the shearing deflection of beams of arbitrary cross-section, either variable or constant, and then goes on to the general discussion of the principles of the calculus of variations and its application to dynamical problems which serves as a basis for the presentation of the Ritz method.

The Ritz method is applied in this case to the problem of finding the fundamental tone of free vibrations of vessels, the hull of a vessel being here considered as a free-free bar of variable cross-section irregularly loaded. (Paper read at the General Meeting of the Society of Naval Architects and Marine Engineers, in Philadelphia, November 14-15, 1918, abstracted from advance copy, 30 pp., *mA*)

THICKNESS OF WALL FOR TUBES UNDER PRESSURE, M. Suwalski (*Zeits. Vereines Deutsch. Ing.* 62. pp. 551-552, Aug. 17, 1918). Gives formulæ for the thickness of tube required to withstand given pressures, using the simple formula $pd = 2sk_2$, where p is the pressure in kg./cm.^{2}, d is the inner diameter, s the thickness of the tube, and k_2 the tensile strength in kg./cm.^{2}. This simple equation is modified by putting $k = A(1 + d/200)$, A being a constant depending on the value of p. (*Science Abstracts*, Section A—Physics, vol. 21, pt. 10, no. 250, October 21, 1918, p. 404, *t*)

METAL-WORKING TOOLS

MACHINE TOOLS FOR NEVILLE ISLAND GUN PLANT. Two new types of single-apparatus shell-turning and boring machines are being built for the Neville Island Gun Plant of the United States Steel Corporation.

The machines are practically identical as to bed and headstock. The bed is 29.9 ft. long, 5.25 ft. wide, and the turning machine has a 39-in. swing. The bed is a solid piece integral with the head. The machines are designed to turn 12-in., 14-in., 16-in. and 18-in. shells, with provision made for 20-in. shells if that size is desired.

The auxiliary carriage is provided with two tools, one for turning the straight portion and the other the curved surface at the nose at the same operation. Back of the carriage, rigidly fixed to the bed, is a forming attachment with two cam slots, one straight and one slightly diagonal controlling the tool turning the straight portion, and the other curved and engaging the tool for the curved portion at two points. As the carriage travels it carries the cutting tools that have the curved surface, being held at right angles to the surface at all times, thus eliminating any necessity for the shells being turned in steps. The action of this curved cam slot is to carry the tool through an arc as though it were operated on a pivot. (*Iron Age*, vol. 102, no. 18, October 31, 1918, pp. 1071-1074, 5 figs., *d*. Also in *Iron Trade Review*, vol. 63, no. 18, October 31, 1918, pp. 1012-1013, 2 figs., *d*)

MUNITIONS (See Metal-Working Tools)

POWER GENERATION

WIND POWER FOR ELECTRICITY GENERATION, P. Schubach (*Helios*, 24. no. 17. 1918, *Elektrot. u. Maschinenbau*, 36. p. 385, Aug. 25, 1918, Abstract). The author calls attention to the rapid multiplication of wind-power installations in Denmark, and considers that their employment will become even more general in country districts as a result of the war.

Wind-velocity observations at Lindenberg Observatory have shown that in low-lying districts at sea level the mean wind velocity is 4.7 m. per sec.; at 500 m. this rises to 8.9 m. per sec., and at 1000 and 1500 m. to 9.2 and 9.4 m. per sec. respectively. The energy available, N, for the wind motor can be calculated from the formula $N = YFv^3\,(150\,g)$, where F is the projection of the total wing surface in square meters, V the wind velocity in meters per second, Y the weight of 1 m.^{3} of air, and g the acceleration due to gravity.

Table 5 gives the relation between size and output of wind motors for wind velocities of 5 and 7 m. per sec.

Reference is made to the wind motors of the G. R. Herzog Saxon Steel Wind-Motor Co., of Dresden. In these the dynamo is driven by means of gearing and countershaft. Auxiliary wind

wheels serve for rotating the main wheel according to the wind's direction and for adjusting to the wind's intensity. The main wheel is mounted on a wooden or iron tower in such a way that

TABLE 5 RELATION BETWEEN THE SIZE AND OUTPUT OF WIND MOTORS

Wheel Diam. in Meters	F in Sq. Meters	Hp. Developed 5 m. per sec. wind velocity	Hp. at 7 m. per sec. wind velocity
2.5	2.9	0.16	0.6
3.5	5.2	0.3	1.0
4	7.2	0.5	1.5
5	11	1.0	2.5
6	16.7	1.5	4
7	22.4	2.0	5
8	28.8	2.5	6
10	44	4	8
12	65	6	14

the lower edge of the wheel clears by 2 or 3 m. any obstacles there may be to the wind over a radius of 200-300 m. The irregular operation of such a motor necessitates the use of a storage battery to work in parallel with the dynamo, and this battery should be capable of supplying two days' current requirements. The cost of operation is given as 4 to 7 pfennigs per hp.-hour, or 120 to 210 shillings per hp.-year, including interest, amortization, and attendance.

Two suitable regulators are then described: these appear to be of the usual type, namely, an automatic cutout operating when the speed falls below a certain value, and a voltage-regulating centrifugal governor which operates the field resistance of the dynamo. (*Science Abstracts*, Section B—Electrical Engineering, vol. 21, pt. 10, no. 250, October 31, 1918, p. 363, *g*)

POWER PLANTS

ECONOMIC OPERATION OF STEAM TURBO-ELECTRIC STATIONS, C. T. Hirshfeld and C. L. Karr, Members Am.Soc.M.E. Discussion of economies which may be effected in the use of fuel through the application of proper operating methods at large turbo-generator power plants.

It is stated that in a single plant with a given load curve the fuel economy is dependent upon the following three independent factors, namely:

1 The method used in distributing the load between the main units available
2 The methods used in the boiler room for producing the steam required
3 The methods used for obtaining auxiliary power for house service.

In connection with the matter of distribution of load between main units, the paper points out that most of the steam-driven turbo-generators built in this country have steam characteristics of the general type shown in Fig. 18. The total steam consumption increases approximately according to a straight-line law until a point is reached where the rate of increase becomes more rapid, causing the plot of total steam consumption to curve upward as shown in the figure.

The steam pressure, superheat and vacuum or back pressure all have marked effects on the steam consumption or water rate of steam turbines, which latter also varies from time to time for a given unit under given conditions of pressure, superheat and vacuum. This supplementary variation may be due to deposits on blading, wear of blading, variation of clearances, settlements in bearings, and other uncontrollable factors.

It is therefore advisable to test each machine through its entire range of load once in every eight weeks at stations operating continuously. Tests at about five or six equally spaced loadings generally suffice to determine the water-rate curves with the required degree of accuracy.

As regards the method of determining load distribution, it is stated that the distribution of load between units so as to yield the minimum water rate for any given station load may be determined mathematically, but this method has not yet been reduced to a form easily understood and applied. Hence a less exact but easy-of-application cut-and-try method is described.

As regards the operation of auxiliaries, the writers arrive at the following conclusions:

1 The smallest thermal cost for auxiliary power is incurred when generated by steam with complete absorption of the exhaust in the feedwater
2 The greatest possible part of all of the auxiliary energy required can be obtained in this way when the steam drives used with the auxiliaries have the greatest possible thermal efficiency
3 Auxiliary power in excess of that obtainable with exhaust steam absorption can be procured from the main generators in electrical form at a lower thermal cost than in any other way.

To these conclusions may now be added two commonly known facts:

1 The increasing price of fuel is leading more central stations to the use of economizers
2 The greatest saving is effected with economizers when the water supplied them is at the lowest permissible temperature. This value is probably somewhere between 120 deg. and 150 deg. fahr., depending upon the types of economizer used and the care with which it is operated.

The writers show that large errors can be made in the original design of supplying auxiliary power. It is also possible to make costly errors in operation. To illustrate: Assume that in a certain station, operating at normal day load, the total amount of power used for auxiliaries and for house service of all kinds amounts to

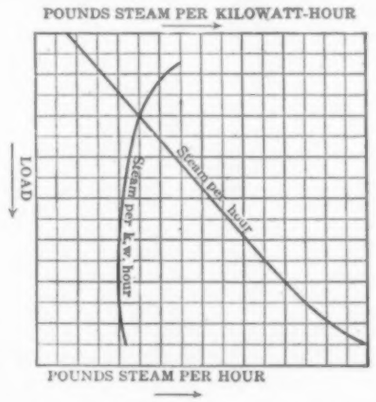


FIG. 18 STEAM-CONSUMPTION CURVES FOR TURBO-GENERATOR

10 per cent of that sent out. This is a figure that should not be exceeded but is often equaled. Under these conditions, for every 1000 kw-hr. sent out of the station it is necessary to produce 100 kw-hr. for the operation of auxiliaries, station lights, etc.

If it be assumed that the main units are capable of producing a kilowatt-hour for 20,000 thermal units in fuel fired it is possible to show the decidedly weighty influence of the thermal cost of auxiliary power.

It has been shown that auxiliary power may cost anywhere between about 4500 and 200,000 thermal units, depending on the method used. At 4500, the auxiliary power would cost about $4500 \times 100 = 450{,}000$ thermal units in the assumed case. This would be equal to about 2.25 per cent of $20{,}000 \times 1000 = 20{,}000{,}000$ thermal units required by the main units. On the other hand, if the auxiliary power costs 200,000 units per kw-hr. the total would be $200{,}000 \times 100 = 20{,}000{,}000$, or exactly the same as that required by the main units.

With all auxiliary power taken electrically from efficient main units the cost would probably be at least 23,000 units per kw-hr. This would give a cost in the assumed case equal to $23{,}000 \times 100 = 2{,}300{,}000$, or about 11.5 per cent of that required by the main units for the generation of power leaving the station. (*U. S. Bureau of Mines Technical Paper* 204, *pg*)

RAILROAD ENGINEERING

Dimensions of Air Passages in Locomotive Grates

HEAT LOSSES IN LOCOMOTIVES. Data of tests on steam locomotives carried out by the Prussian Railroad Administration in 1913. This series of articles started in 1917, but the issues previous to that from which this abstract is made are not available in this country at the present time.

The present section describes tests made to determine the losses through conduction, radiation and smokestack. These losses are usually assumed to be on the average 5 per cent. The values of line 7 in Table 6 have been obtained by planimeter summation of areas. From these average values have been derived coefficients of evaporation calculated in the usual manner.

The most interesting part of this particular series of tests was that through which it was intended to determine the relation between the free grate area to the total grate area and its influence on the rate of combustion. To do this it was necessary to determine the pressure which should be used with various dimensions of the free grate area to force through the uncovered part of the grate the amount of air necessary for good combustion. The average excess air is assumed to amount to 30 per cent. If one kilogram of coal consumed contained, for example, 0.72 kg. of carbon, 0.05 kg. of hydrogen and 0.12 kg. of oxygen, then with an average consumption of 450 kg. per sq. meter per hour and a grate area (of the test locomotive) of 2.3 sq. meters, the total amount of air necessary per second is

$$L = \frac{100\,(\frac{8}{3}\times 0.72 + 8\times 0.05 - 0.12)\,450\times 2.3\times 1.3}{23\times 1.29\times 3600} = 2.78 \text{ cu. m.}$$

This shows that if the free grate passages constituted 23.3 per cent of the total grate area, the velocity of air flowing through the grate slots is

$$v_1 = \frac{2.78}{0.23\times 2.3} = 5.3 \text{ m. per sec.}$$

which corresponds to a pressure of

$$h_1 = \frac{5.3^2\times 1000}{2\times 9.81\times 775} = 1.85 \text{ mm. water}$$

For a free grate area of 45 per cent, the velocity becomes

$$v_2 = \frac{2.78}{0.45\times 2.3} = 2.7 \text{ m. per sec.}$$

and the pressure

$$h_2 = \frac{2.7^2\times 1000}{2\times 9.81\times 775} = 0.48 \text{ mm. water}$$

From line 11 in Table 6, it is found that the total pressure difference between the ashbox and the firebox is with upper Silesian coal between 30 and 40 mm. of water and with Westphalian coal 45 to 60 mm. The free grate area can, therefore, within the above-named limits, have only a slight influence on the total difference in pressure between the ashbox and the firebox, even under the assumption that the values of pressure calculated above may be raised somewhat through the existing subdivision of the total free cross-section of the grate.

It appears, therefore, that with the definite action of the air injector and with the definite height of the coal bed, the dimensions of the free grate area may vary within fairly wide limits without materially affecting the amount of air driven in, and hence the quality of combustion.

The lower value of the free grate usable seems to lie at about 20 per cent. If it be decreased further there appears on one hand an enhanced resistance which increases with the square of the velocity of the air; and on the other hand, the distribution of the air becomes defective which leads to the formation of slags. (*Annalen für Gewerbe und Bauwesen*, vol. 82, no. 1/973, January 1, 1918, pp. 1-4, serial article, *e*)

TABLE 6 DATA OF TESTS TO DETERMINE BEST DIMENSIONS OF SLOTS IN LOCOMOTIVE FURNACE GRATES

Number of Test	1	2	3	4	5	6	7	8	9	10	11	12	13	Runs 54	55	56	57	58	59	60	61	62	63	64	65	66	67
														to	from	to	from	to	from	to	from	to	from	to	from	to	from
Free grate surface in per cent $= \frac{F}{G}\times 100$		40		40			45.8				23.3			33.3		41.3		40		45.8		23.3		41.3		33.3	
Grate Dimensions in mm. { Width of slot		12	Double bars	12			15				10			10		15		12		15		10		15		10	
Grate Dimensions in mm. { Thickness of grate		12		12			12				25			15		15		12		12		25		15		15	
Type of Coal	Various German Coals in Good Grades																										
Lower Heat Value in large calories determined by calorimeter		6840		8142		6800		8142		6847		8100		6847	7793	6847	7900	6750	8142	6363	8100	6900	7700	7986		7500	
Amount of Coal in kg. burned per sq. m. of grate surface per hour	483	590	435	359	435	478	370	325	305	400	412	348	261	456	413	456	370	476	398	489	400	540	440	423	285	465	355
Water in kg. evaporated per sq. m. of heating surface per hour	55	52.4	50	51.2	53	54	44	45	36	54	47	47	37	53.5	50	50	48	49.6	41.2	47.5	39.5	52	46	50.2	36.7	51.1	38
Average Heat Losses in per cent { Ash	5	6.3		5	6	7.6	5	5.6	4	6	6	3.5	5	5.3	7.4	4	7.5	4	11	6.5	9	11	10	8.6	9	9	5
Average Heat Losses in per cent { Radiation	2	0.5		1	1	2.2	2	1.2	1.7	1	1	0.4	0.5	1.1	0.6	1	0.5	1	1.5	1	1	0.5	0.5	1	1.5	1	1.0
Average Heat Losses in per cent { Losses to the exhaust	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	13	17.4	12.8	14.2	10	11.5	11.7	13.8	12.5	11.9	11.7
Average Heat Losses in per cent { Unburnt gases														0.6	1	1	2.	3.6	11	5.3	23.4	9.6	12.3	8.2	2.8	11	14.6
Average Total Loss in per cent														28	28	27	28	31	41.3	32	48.4	37.6	39.5	36.6	30.8	37.9	37
Average Superheat in deg. cent														282	366	322	311	310	284	300	285	315	295	295	280	285	282
Average Boiler Gage Pressure in atmos	11.9	12.2	12.2	12.2	12.3	12.2	12.3	12.2	12.3	12.3	12.3	12.2	12.3	12.2	12	12.4	12.4	12	11.4	12	11.6	11.8	11.5	12	12	11.9	11.6
Average Vacuum in mm. of water { In ashbox	10	11	11	11	10	12	7.5	6	5	13	10	8	3.5	11	4.5	7	6	6.5	4.5	6	2	5.5	2.5	9.5	13.5	4.5	4.5
Average Vacuum in mm. of water { In firebox	33	37	40	39	52	40	30	39	38	39	33	41	41	36	57	43	60	37.5	60	41	52.5	47	70	56	50	42	34
Average Vacuum in mm. of water { In smokestack	100	100	100	97	116	110	76	100	73	105	82	102	72	108	108	98	102	81.5	85	94	76	94	110	97	75	87	68
Evaporation { Determined by test	6.79	5.27	6.85	8.48	7.25	6.71	7.06	8.25	7	6.55	6.79	7.95	8.42	7	7.16	6.57	7.76	6.2	7.1	5.8	5.87	5.74	6.18	7.05	7.68	6.57	6.4
Evaporation { Calculated	..	..	..	..	..	..	..	..	..	..	..	..	..	6.9	7.1	6.8	7.8	6.3	6.8	6.1	5.7	5.8	6.3	7	7.8	6.6	6.6

Influence of Internal Fissures in Rails

RAILS AND THE ACCIDENT ON THE LONG ISLAND RAILROAD. On April 15, 1918, there was a derailment of a troop train on the Long Island Railroad, near Central Islip, New York.

Investigation indicated that the cause of the accident was due

to the failure of two rails in which a number of transverse fissures were present. The rails were 80 lb. in weight, A. S. C. E. section, bessemer steel, rolled by the Lackawanna Iron and Steel Company. Each rail displayed a number of transverse fissures, some of which were visible and one accidentally discovered through nicking which happened to be done in the vicinity of a transverse fissure which had not reached the periphery of the head.

The appearance of the fissures is shown by microphotographs, two of these fissures having increased in size to such an extent that they had reached the periphery of the head on the gage side. Other fissures have not become exposed externally. The rails when polished and etched were shown to be structurally very unsound and this lack in uniformity had also been observed in machining the rail sections. Portions of the cross-section were spongy; other parts were hard and machined with difficulty.

From information acquired it appears that at the time when these rails were rolled, or about 1897, the Lackawanna Iron and Steel Company used horizontal heating furnaces, soaking pits not having then been introduced.

The internal stresses in the two rails were measured, and the results are shown in the original report by means of diagrams.

It is interesting to note that from outward appearances the rails were sound looking and showed that little wear had taken place. The shapes of the heads showed but little distortion, yet within them destructive transverse fissures had developed. It is not known over what interval of time these transverse fissures had been in existence. They carried, however, the lighter traffic of the railroad for a period of time without known examples of transverse fissures having appeared. War activities increased the traffic from seven to ten times in the amount of tonnage with a considerable increase in the weight of the equipment, conditions which not unlikely contributed toward the formation of transverse fissures and accelerated their development. The investigation has, however, clearly established that the rails were of very poor metal, a metal, moreover, which appears to have been defective even at the time the rails were rolled.

The interesting features of the report are data of an investigation on the development of fissures in these rails and the distribution of internal stresses in the various parts of the cross-section.

The report comes to the conclusion that from information thus far obtained it appears that rails are strained higher than other classes of engineering materials. Another section of the report tells of annealing tests on a number of hot-forged bars of rail steel and other grades. In these annealing processes were used cooling by an air blast, quenching in oil and quenching in water. The tests with rail steel were fairly consistent, but tests on low-carbon steel and chrome-nickel steel furnished results of a paradoxical nature. The chrome-nickel bars conformed in behavior to the rail steel, while the low-carbon steel displayed opposite characteristics and contracted in length when heated and quenched, whether oil or water were used as the quenching medium.

It is claimed that a distinction may properly be made between approximate cause of the formation of transverse fissures and features which may promote or retard their inception and progress. In any event, transverse fissures are shown to be a progressive type of fracture. (Report of the Chief of the Bureau of Safety, Covering the Investigation of an Accident Which Occurred on the Long Island Railroad, near Central Islip, New York, on April 15, 1918, *Interstate Commerce Commission*, August 5, 1918, 45 pp., 70 figs., *epA*)

STEAM ENGINEERING

A Large Turbo-Alternator Unit

45,000-KW. CROSS-COMPOUND STEAM TURBINE. Description of the turbo-generator unit recently put in service in the Brunot's Island Power Station of the Duquesne Light Company at Pittsburgh, Pa.

Essentially the unit is not radially different from others of the same type; the principle of cross-compounding in steam turbines not being new any longer. A new feature, however, is the installation of a device for cutting out one side of the turbine if for any reason its immediate removal from service becomes necessary; this device may also operate automatically. In this way a 45,000-kw. machine has the flexibility of a 22,500-kw. unit.

Each turbo-generator rotor is supported in its own bearings so that four bearings are required for each element. The bearings are self-aligned and are supported on spherical keys with sheet-metal liners of different thicknesses for horizontal or vertical adjustment. Oil for lubrication is admitted to the bearing casing at the bottom, the sides of the bearing being eccentrically relieved for a space of about 35 deg. above and below the center line to within an inch of the end, to provide a reservoir of oil along each side. The turbine is free to expand axially by sliding on its supports, which are applied directly below the horizontal joints, the turbine itself being anchored to the inboard generator pedestal.

The low-pressure rotor is composed of a central hollow drum rigidly secured to the spindle ends, on each of which are pressed two blade rings or disks carrying the low-pressure blades. The maximum mean velocity of the blades is only 515 ft. per sec., which brings the rotating stresses at 20 per cent overload to less than 20,000 lb. per sq. in., and makes it possible to use a good grade of cast steel in the blade rings. This is safer and better than using special-grade steels which are not only hard to get even in normal times, but may carry undetected flaws and are more

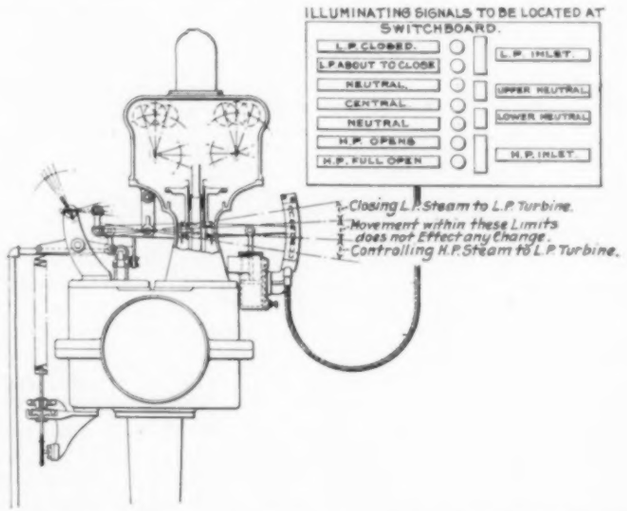


FIG. 19 LOW-PRESSURE TURBINE GOVERNOR ON THE 45,000-KW. CROSS-COMPOUND STEAM TURBINE AT DUQUESNE

subject to trouble from improper heat treatment. Phosphor-bronze blades are used except in the last three rows of the spindle, which are drop-forged steel.

Each turbine is provided with an overspeed-stop governor which will shut off steam in that unit in case the speed should rise 10 per cent above normal. Each unit also has a speed-control governor. The one on the high-pressure turbine which normally controls the steam supplied to the whole system is of the customary form. The governor on the low-pressure side, Fig. 19, has some special features.

The low-pressure governor should not be called upon to act except in the case of an emergency, and in order that the switchboard operator may be aware of the state of things, a system of signal lamps is arranged to show the position of the governor in the neutral zone. By changing the tension of the speed-changer spring, the governor may be kept in its middle position so that a normal fluctuation of frequency will not cause the governor to function. The spring on the low-pressure governor is designed to give a total speed range of 12 per cent, which is divided up as follows: Starting from the central position, if the speed rises 4 per cent, the governor is on the verge of tripping the low-pressure inlet valve. With a further rise of less than 1 per cent the valve will be tripped shut, one more per cent travel being provided for clearance. From the central position downward, should the speed decrease 2 per cent, the high-pressure valve will begin to open,

and will be full open after 3 per cent more decrease. Another 1 per cent is also provided at this end for overtravel.

The signal lamps in the switchboard gallery, Fig. 19, are controlled from the low-pressure governor by a system of contacts operated by an extension on the governor lever. As the governor moves between its inner and outer position this lever travels across the contacts, registering its position on the illuminated sign.

To review the system briefly: If the circuit breaker on the low-pressure element should open due to a short-circuit, the turbine will speed up and close the steam inlet from the high-pressure cylinders. The high-pressure turbine will continue to run, carrying its load and exhausting to atmosphere, while the low-pressure turbine, with its source of steam cut off, will fall in speed until reaching 2 per cent below normal, when the governor valve will admit high-pressure steam. In the meantime, if the line has been cleared the unit may be synchronized and reconnected to the bus bars, the gate valve opened, and the low-pressure cylinder receive its steam as before. If the low-pressure turbine for similar reasons should overspeed 10 per cent and the automatic stop operate, it will result in the automatic closing of the high- and low-pressure steam inlets, and the opening of the circuit breaker, and this half of the turbine will be entirely shut down. The high-pressure element, however, will continue to run non-condensing and carrying its load as usual. (*The Electric Journal*, vol. 15, no. 11, November 1918, pp. 435-441, 7 figs., *d*)

DEVELOPMENT OF STEAM-BOILER BAFFLES, Albert A. Straub. Descriptions of several types of baffles with illustrations and brief criticisms. In the same articles are presented data of tests made on a type of baffle shown in Fig. 20 as applied to a Stirling boiler. Tests made with this arrangement gave excessive flue-gas temperatures at 150 per cent rating, which led to a change in location of the baffles and closing up of baffle openings as shown in Fig. 21. With this arrangement of baffles the capacity of the unit was not decreased, but the temperature of the escaping gases was decreased 60 deg. fahr. at 150 per cent rating and 70 deg. fahr. at 210 per cent rating with a corresponding effect in efficiency.

A further change was made in this baffle arrangement after the tests had been completed by placing the first baffle back of the second row of tubes and extending the last baffle down 24 in. toward the mid-drum. This change reduced the temperature of escaping gases 50 deg. fahr. at the higher ratings.

The ratio of efficiency to capacity for the unit with baffling shown in Fig. 21 is given by the curve of Fig. 22. Several other interesting tests are reported in considerable detail in the original article. (*Power*, vol. 48, no. 19, November 5, 1918, pp. 656-659, 9 figs., *de*)

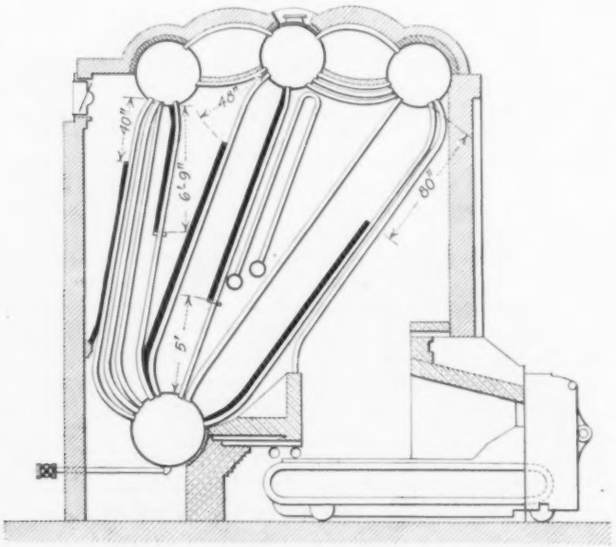


FIG. 20 BAFFLES WHICH GAVE EXCESSIVE FLUE-GAS TEMPERATURES AT 150 PER CENT RATING

AVOIDING DISTORTION IN TURBINE OPERATION, Webster Tallmadge, Mem.Am.Soc.M.E. Brief discussion of the causes of distortion and suggestions for practical methods so to operate the turbine as to avoid this occurrence. Valuable suggestions are given as to turbine and steampipe installation so designed to insure safety in this respect. (*Power*, vol. 48, no. 22, November 26, 1918, pp. 762-765, 8 figs., *p*)

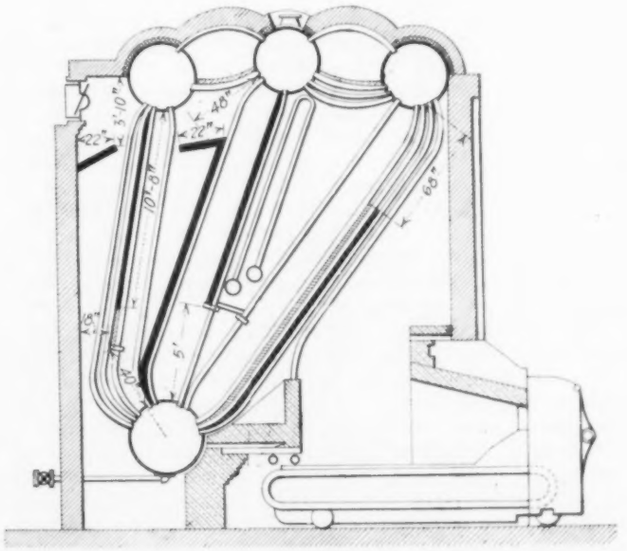


FIG. 21 BAFFLES THAT CAUSED A DECREASED FLUE-GAS TEMPERATURE

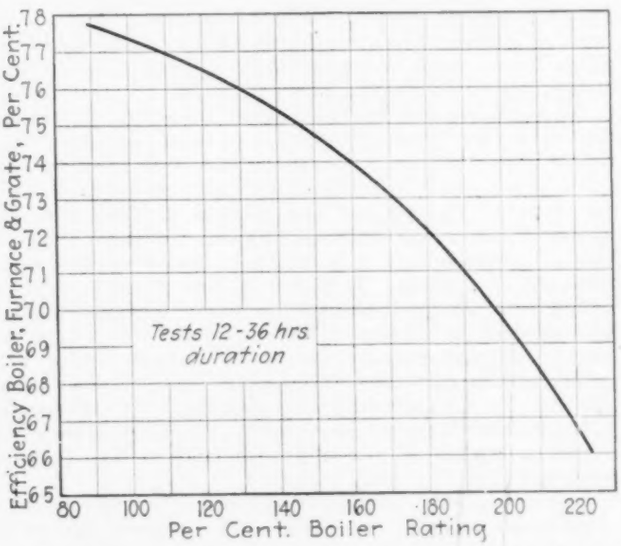


FIG. 22 RATIO OF EFFICIENCY TO CAPACITY OF BOILER BAFFLE AS SHOWN IN FIG. 21

TESTING

PHYSICAL TESTS OF ROLLED SHELL STEEL, James J. Mahon. The physical variations in rolled steel are sometimes greater than might be expected from chemical variation. This variation in physical properties is not found to enter any particular bar of the rolled ingot and at times is much more than the variation usually found between the inner and outer portions of the cross-section of the ingot. It would appear that this might be attributed to the direct rolling of the steel after a prolonged heating which leads to precipitation of the ferrite during the heating process. An investigation was made during which tests and photomicrographs were taken from a great many heats of steel and it was found that

the precipitation of ferrite in some heats was greater than in others. Heats of steel which failed on preliminary tests but in which the precipitation of ferrite was not excessive usually passed the physical requirements after forging.

Although the reheating of the material was too rapid to be classed as a heat-treating operation, it answered the purpose for such steel as was not badly affected. It was found that the ferrite was reabsorbed at a temperature of 1450 deg. fahr., but the quality of the steel was not impaired when the temperature was carried as high as 1750 deg. fahr. before cooling.

It is suggested that the weakness in the metal caused by the precipitation of ferrite might be eliminated by a double rolling operation consisting of breaking down the ingots into blooms and then reheating them before the final rolling.

FIG. 23 PHOTOMICROGRAPHS OF SHELL STEEL FROM TEST BAR TAKEN FROM A DIRECT ROLLED SECTION

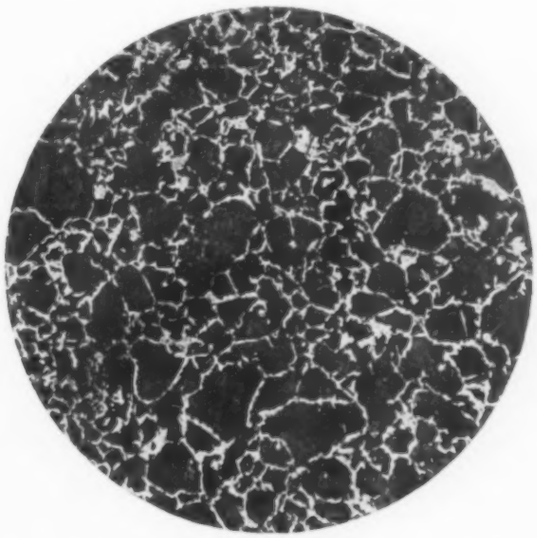


FIG. 24 PHOTOMICROGRAPHS OF SHELL STEEL FROM TEST BAR TAKEN FROM A SECTION AFTER HEAT TREATMENT AT 1450 DEG. FAHR.

In Fig. 23 the structure of the bar rolled direct from the ingot shows the weakness in steel produced by direct rolling or forging after a prolonged heating. Fig. 24 shows the structure after heat treatment at 1450 deg. fahr. Steel in the condition shown in Fig. 23 might to some extent be compared to a metal made up of alternate layers of various thicknesses of soft and hard material welded together.

From this investigation it appears that the extent of inherent weakness in such metal can be determined by the percentage of elongation to the tensile strength, and if so, the data as to percentage of yield to elongation should be a part of every specification where a good quality of steel is desired. (*The Iron Age*, vol. 102, no. 18, October 31, 1918, pp. 1082-1083, 2 figs., *e*)

VARIA

WAR SECRETS. During the visit of the Inter-Allied Petroleum Council in the latter part of November, it was revealed for the first time that a pipe line had been laid across the neck of Scotland, through which oil fuel could be pumped in a cold state at the rate of about 100 tons per hour. The pipe follows the course of the Clyde and Forth Canals, with terminals at Old Kilpatrick and at Grangemouth. At one end 16 huge tanks have been constructed with a holding capacity of a thousand tons, and at the other end the oil falls into reservoirs easily accessible to the fleet from its base at Rosyth. The pipe is 8 in. in diameter and there are two intermediate pumping stations. This is only one of the few secrets revealed since the signing of the armistice.

Another such secret is that the U. S. Navy Department proposes to use argon to inflate gas bags in balloons. This item has been taken from an official statement issued by the Navy Department. It should be added, however, that it is by no means clear what it means, since the specific gravity of argon is so close to that of air that it does not appear obvious how any lifting power can be secured by its use.

In connection with aeronautics, another important and well-kept secret has recently been revealed, and that is that the U. S. Navy has developed what is, perhaps, the largest seaplane type known. In a recent test this seaplane officially marked as NC-1 made a flight with 50 men on board.

This is the first American tri-motored seaplane, being propelled by three Liberty motors that develop a maximum of 1200 hp., giving it a cruising speed of 80 miles an hour. The flying weight of the machine is 22,000 lb., while the weight of the seaplane itself, unloaded and without a crew, is 13,000 lb.

An idea of the size of the big seaplane is shown by the fact that the wing spread is 126 ft., the breadth of the wing 12 ft., and the gap between wings 12 ft.

Recently the NC-1 made the trip from Rockaway to Washington, about 350 miles, in 5 hours and 20 minutes. The flight from Washington to Hampton Roads, 150 miles, was covered in 2 hours and 15 minutes, and the trip from Hampton Roads to New York, 300 miles, took 4 hours and 20 minutes.

Also a further development is revealed by the following statement, authorized by the War Department:

On October 15 Chauffeur R. W. Bottriell, of the 145th Air Squadron, jumped successfully with a parachute from an aeroplane at Kelly Field, San Antonio, Texas. The aeroplane was at an altitude of 4800 ft., nearly a mile high, when the jump was made. There was a strong wind blowing from the north, but Chauffeur Bottriell judged his distances nicely and landed safely in the main landing field. The pilot of the aeroplane stalled the machine slightly just before the jump was made, banking to the right so as to get the tail out of the way of the parachute when Bottriell jumped over the side. A large American flag attached to the parachute during the drop was flying during the descent.

CLASSIFICATION OF ARTICLES

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society. The Editor will be pleased to receive inquiries for further information in connection with articles reported in the Survey.

REVISION OF THE A. S. M. E. BOILER CODE

SECOND only in importance to the completion of the original edition of the Boiler Code, is the work of revision of the Code that has been in progress for the past two years and is now completed. The edition of 1918, which has been revised to incorporate the interpretations that have been rendered by the Boiler Code Committee during the past four years in which the Code has been operative, and also to add provisions for new types of boiler construction as a result of the development of the art, renders the work of the Boiler Code Committee a very comprehensive review of boiler practice in this country, as well as in the Canadian provinces. Its scope has been extended to cover certain additional forms of boiler construction, which were not previously referred to, and it is the belief of the Boiler Code Committee that the Code as printed in the Edition of 1918 is the most complete and exact manual of American boiler practice that has ever been produced.

Like the work involved in the completion of the original edition of the Code early in 1915, the completion of the revision work prior to the publication of the Edition of 1918, has involved an enormous amount of investigative and research work and has demanded immense sacrifices by the individual members of the Committee in the formulation of the changes in the rules. Throughout the past year, both the Committee and the Executive Committee to the Boiler Code Committee have devoted innumerable conferences to the prosecution of the revision work and every detail of the revision has been handled with the greatest possible care in order to make certain that they were presented with the best possible judgment of the various interests involved and that they might not under any circumstances bring hardship to any branch of the industry through any possibility of misinterpretation.

The revision work was begun late in 1916, when, after the widely advertised public hearings that were held on December 8 and 9 following the Annual Meeting of that year, large numbers of boiler manufacturers, users and experts came before the Committee to recommend preferred revisions in the rules, and it has continued uninterruptedly since that time with the idea of developing the proposed modifications in time for the report thereupon at the time of the following meeting. Such, however, were the obstacles encountered in arriving at complete agreement with the various other associations and organizations interested, that it was not until late in 1918 that it was possible to approach completion. The revisions of the Power Boiler section of the Code (Part I, Section I) were completed and reported to the Council of the Society at its meeting of September 20, 1918, and there approved; the revisions of the Heating Boiler section were not, however, completed for reference to the Council until its meeting of December 3, 1918, whereupon the revisions were finally approved and the printing of the new edition ordered.

The arrangement of the revised edition of the Code (Edition of 1918) is exactly the same as that of the original edition, consisting of Part I, applying to new installations, and Part II, to existing installations. Part I is further divided into Section I, applying to power boilers, and Section II, applying to heating boilers. The rules are then followed by an Appendix which embraces explanatory notes and recommendations relative to boiler construction and repairs. While the paging of the new edition has been altered to provide for the materially increased volume of the rules as revised, the subjects and the arrangement of the paragraphs have been left unaltered throughout the book in order that references to paragraphs might remain uniform throughout for the greater convenience; this also has the advantage of requiring no alterations to the paragraph numbers in the index, so that the indexing to the original edition will apply equally well to the paragraph numbers of the new edition.

Noteworthy additions are to be noted in the diagram for the determination of the efficiencies of longitudinal and diagonal ligaments between tube holes in cylindrical tube sheets which is inserted in the form of a folder (See Fig. 13 between pages 48 and 49) and the proposed Manufacturers' Data Report form which follows page 128 of the Appendix. Another change that will be readily noted results from the revision of the safety-valve rules embracing the transfer of the Tables of Discharge Capacities for direct spring-loaded pop safety valves to the Appendix. In addition, there are a number of other revisions which will prove of interest to those engaged in the boiler industry.

The edition of 1918 of the Boiler Code is slightly larger than the original edition, embracing 128 pages of text and the two inset folders (Fig. 13 and Figs. 34 and 35); with the Index, which in the new edition avoids the divisional arrangement, there is a total of 146 pages. It is issued in pamphlet form for general distribution, being obtainable in paper cover at 50 cents per copy to members and $1.00 to non-members. Arrangements are being made to issue the Code in the near future in cloth binding for the convenience of those who desire to use it for textbook or reference purposes; the price of the cloth-bound edition will be announced later.

CORRESPONDENCE

CONTRIBUTIONS to the Correspondence Departments of THE JOURNAL by members of The American Society of Mechanical Engineers are solicited by the Publication Committee. Contributions particularly welcomed are suggestions on Society Affairs, discussions of papers published in THE JOURNAL, or brief articles of current interest to mechanical engineers.

The Sinking of the Steamship "Lucia"

TO THE EDITOR:

In response to your request, I am sending you particulars regarding the steamship *Lucia* upon which I presented a paper at the last meeting of the Society of Naval Architects and Marine Engineers.[1] The *Lucia* was an Austrian steamship with buoyancy boxes for which the design and calculations were made by the writer. The work was done at the instigation of the Ship Protection Committee created jointly by the Naval Advisory Board and the U. S. Shipping Board. This Committee consisted of Admiral H. H. Rousseau, A. M. Hunt and the writer.

The *Lucia* was torpedoed about 5 p. m., October 17, about 1250 miles off the Atlantic Coast on her way to the Mediterranean.

According to the evidence of the captain and other officers, the ship was struck in the engine-room compartment just forward of the after engine-room bulkhead on the port side, so low down that the double bottom was undoubtedly destroyed, as well as the drainage connections for the double bottom and other watertight compartments. The explosion was so low that no damage appeared to the plating on the outside of the hull, even when the ship rolled.

At the time of the attack the *Lucia* was drawing 27 ft. 6 in. forward and 28 ft. 6 in. aft, so it will be seen that the torpedo, instead of striking as is usual not more than 10 ft. below the water line, actually struck more than 20 ft. below. The engine room and hold No. 5, the next compartment aft, flooded immediately, and soundings showed water entering holds Nos. 5 and 6.

The ship floated with a slight list to port during the night of the 17th and the next day until 3.20 in the afternoon, or for something more than 22 hours.

The captain and gun crew stood aboard until shortly before the sinking, and stated that they were ready to fight the gun and resist submarine attack on the surface until that time. Nothing, however, was seen of the submarine before or after firing the torpedo.

About noon on the 18th the sea commenced to rise and the wash

[1] An abstract of this paper appears on page 56 of this issue.

of the sea dislodged and loosened the deck cargo of motor trucks. The drive of these trucks finally struck the hatch aft hold No. 6, which finally filled from the deck. The ship then settled aft, standing almost vertical before she finally went down.

It will be understood, as set forth in the paper, that the displacement of the double bottom had been depended upon for reserve buoyancy. This was partially eliminated by the unusual amount of fresh water carried, and the remainder by the destruction of the pump connections to the double bottom. The destruction of these connections also admitted water to all other compartments aft through the drainage connections, thus eliminating any buoyancy ordinarily maintained by watertight compartments.

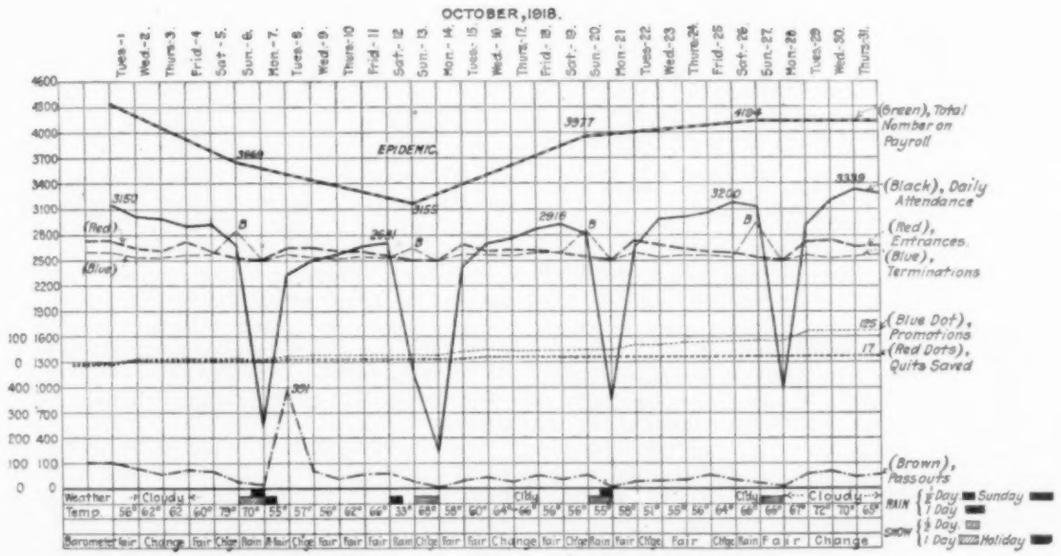
Altogether it is to be noted that the torpedo in this instance made a perfect hit. It is hardly conceivable that it could be so precisely located by the hand of chance or coincidence.

At the time of the fitting out of the *Lucia* ships were being torpedoed at only a moderate distance from the coast, and mainly in the English Channel and approaches thereto. Had the *Lucia* been torpedoed anywhere within 100 miles of the coast she would in all probability have been safe. Attention should also be called to the fact that other vessels torpedoed in the engine room—destroying their bulkheads—have gone down in from eight to ten minutes.

While the result of this practical test of the *Lucia* is not all that was hoped for, the writer believes that when carefully considered in all its bearings, it is a very considerable contribution to the possibility of rendering ships, with the lives of their crews and their cargoes, more safe at sea.

WILLIAM T. DONNELLY.

New York, N. Y.



STABILITY CHART IN USE AT THE WORKS OF THE CHESTER SHIPBUILDING CO.

lines on the last day of the month indicate the total number of promotions and quits saved during the month.

Brown ink is used for the "pass outs," a list of which is secured from the time department daily. The line begins where the line of the preceding month ended, and varies daily. The pass outs include all men who leave the yard during the day, and the number is affected by the weather to a large extent.

Sundays and holidays are indicated at the bottom of the chart, in purple and red, respectively. Columbus Day was not a holiday, yet its influence on the working force is made evident on the chart. The epidemic made its influence felt, likewise. The weather conditions and temperature are also indicated, as rain, excessive heat or extreme cold affect the working force, and likewise the stability chart.

The date and days of the week are placed at the top of the chart, making a concise report of the working force in such form that reasons and results are shown at a glance.

M. E. HOOD.

Chester, Pa.

Working-Force Report—Stability Chart

TO THE EDITOR:

We have in use, in the employment department at the works of the Chester Shipbuilding Company, Chester, Pa., what we term a stability chart which may be of interest to readers of THE JOURNAL. The stability chart is another form of the turnover report and is based on the daily labor reports which are made out on blanks. The stability chart gives, by comparative colored lines, the details with regard to the working-force reports for each month.

The chart uses two scales—300 men to the block for the daily attendance and payroll; 100 men to the block for all other reports.

The payroll is indicated by a green line near the top of the chart; the figures used in plotting this line are secured from the paymaster and indicate the number of pay envelopes given to the yardmen each Saturday. For that reason there is a regular gradation of line from one Saturday to the next. This line begins with the figures of the last payroll of the preceding month, and ends with the last payroll of the current month. Scale, 300 men to a block.

The figures from the black daily attendance line are secured from the daily labor reports and include both the day and night forces. As its name implies, it fluctuates from day to day, taking a decided drop on Sundays. A comparison of this line with the payroll shows the approximate number of daily absentees. This comparison of a daily with a weekly record will not be exact.

The terminations are shown in blue, the entrances in red. These two lines begin with the record of the last day of the preceding month, and are changed daily according to the number of men entered and terminated each day by the employment department. These lines usually follow each other quite closely, the terminations being greater at the end of the week, the entrances at the beginning.

The promotions in blue dot and the "quits saved" in red dot are cumulative. The lines begin at zero, and the positions of the

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D. ROBERT YARNALL.....Philadelphia, Pa.
FRED N. BUSHNELL.....Boston, Mass.

Terms expire December 1921

CHARLES L. NEWCOMB.....Holyoke, Mass.
FRANK O. WELLS.....Greenfield, Mass.
CHARLES RUSS RICHARDS.....Urbana, Ill.

PAST-PRESIDENTS

JAMES HARTNESS.....Springfield, Vt.
JOHN A. BRASHEAR.....Pittsburgh, Pa.
D. S. JACOBUS.....New York, N. Y.
IRA N. HOLLIS.....Worcester, Mass.
CHARLES T. MAIN.....Boston, Mass.

CHAIRMEN OF THE STANDING COMMITTEES OF ADMINISTRATION

FINANCE
MEETINGS AND PROGRAM
PUBLICATIONS AND PAPERS
MEMBERSHIP
SECTIONS
CONSTITUTION AND BY-LAWS

TREASURER

WILLIAM H. WILEY.....New York, N. Y.

SECRETARY

CALVIN W. RICE.....New York, N. Y.

EXECUTIVE COMMITTEE OF THE COUNCIL

MORTIMER E. COOLEY, *Chairman*.....Ann Arbor, Mich.

The Secretary's Letter

THE Annual Meeting which has just closed developed a fine spirit and sounded a high note in respect to the ideals which the Society and its members are striving to attain. From the time of the conference of the Committee on Aims and Organization held just previous to the meeting and continuing, through the addresses and even in the papers, notably in the one by Mr. R. B. Wolf on the Non-Financial Incentives in Industry, this spirit was everywhere manifest.

The Society is in tune with the high purpose of the Nation, or to state the matter in another way, of which I have for a long time thought the engineering profession deserving, the engineer is as responsible as any other citizen for the high ideals of this Nation which President Wilson has been able to so forcefully state. It is highly creditable and encouraging to us either helping to form the Nation's ideals or being abreast of the times.

In keeping with our professions we have sent President Main to France in response to the invitation from the French engineers who are working under government auspices on reconstruction problems.

With the many tasks at home the Society needs also the constructive genius of the entire membership—first, in assisting all returning officers and men to positions. Please promptly write the Secretary of any opportunities under your observation. Second, in securing business for industries so they may be quickly adjusted to a peace basis. In either case, if you do not write the Secretary, at least notify the local committee of your city, which is one of the committees of "readjustment" for the Society. Third, in supplementing the work which our President will do abroad, and which, as we understand it is only preliminary. If you are available for foreign service, please advise the Secretary in what capacity you could best serve and the conditions under which you could go abroad.

Members will recognize that the emphasis in the above is on the things that we can do, rather than on the benefits to be derived by the individual members. While the Society is alive at all times to the necessity of improving its service to the membership, and suggestions are urgently requested in that regard, the Secretary believes that its resources should be devoted to the profession in so far as possible and that this should be the first consideration of a member, rather than what he may personally get out of the Society.

In this connection we take special pride in the purchase by the Society of *The Engineering Index*, elsewhere announced. This service we shall give regularly to the membership. We propose to make THE JOURNAL the most indispensable paper you receive.

CALVIN W. RICE,
Secretary.

"Mechanical Engineering"

The first monthly publication of the Society was known as the "Proceedings," a title which correctly interpreted its contents, comprising the reports of the Annual and Spring Meetings, the New York meetings and the chronicle of its committee activities.

With the growth of the Sections, however, the material which came to the publication was considerably broader in its scope and the name was changed to "The Journal." The Sections now number 26, representative of nearly every part of the country, and other Sections are forming. Each Sections Committee is virtually an editorial committee which solicits contributions for its meetings and for later publication in THE JOURNAL—contributions which are representative of the engineering progress in the particular vicinity where the Section is located.

Added to these is the review of American and foreign periodicals which appears in THE JOURNAL, and now, beginning with this number, is the incorporation of The Engineering Index. The field of THE JOURNAL has become so broad, therefore, that the Publication Committee has decided to adopt the name "Mechanical Engineering" as correctly descriptive of its contents.

The Engineering Index

When THE JOURNAL was started in 1906, a committee, of which the late Professor Hutton was a member, was appointed by the Council to outline a plan for its development. An important feature which has since been worked out step by step by the Publication Committee was to be the reviewing and indexing of the large group of periodicals in the Library, comprising substantially the current engineering publications of the world.

The first step was taken in 1912 by the establishment of the Foreign Review, which later was extended to include English and American periodicals and a selected list of titles of articles in the technical press. During the past few months these selected titles have been greatly extended, and have covered the leading articles in mechanical engineering and related fields.

Beginning with this number of THE JOURNAL, another important step has been taken of great significance, in the purchase by this Society of the Engineering Index, published for many years by the Engineering Magazine Company and widely known among engineers and in libraries throughout the world as the leading index of current periodical literature.

The Engineering Index had its inception in the personal need felt by Prof. J. B. Johnson of Washington University, St. Louis, and who began in 1883 to index periodicals on his own account in order to keep more closely in touch with engineering progress. At that time he was a member of the Board of Managers of the Association of Engineering Societies which until within a few years has published a journal containing the papers presented before the several societies comprising the association.

At Professor Johnson's suggestion, the Index was incorporated in that journal and published by it until 1895, when its Board of Managers turned over the Index to the *Engineering Magazine*, with its greater facilities for the production of the Index.

The Index has since appeared regularly in the *Engineering Magazine*, and in *Industrial Management*, the title which the magazine now bears. It has also been issued as a separate publication for those who desire it in this form, and the items have been collated and published in yearly volumes.

It was felt by Mr. John R. Dunlap, publisher of *Engineering Magazine*, that its field had now become so specialized that the services which the Engineering Index could give would be greatly enhanced if the Index were to be conducted by an institution like this Society, with the facilities of the Engineering Societies Library at its disposal and with the possibility of coöperation with other similar organizations for its extensive development.

It requires but little imagination to picture the possibilities and the utility of such a descriptive index when brought to the point where it covers with thoroughness the whole field of engineering.

To show the spirit in which the transfer of the Index was made, two letters follow, one from the Secretary of this Society to Mr. Dunlap, and the reply from Mr. Dunlap.

DEAR MR. DUNLAP:

You have built up a distinctive service known as "The Engineering Index." You can be proud of the achievement. The Society in acquiring it, pledges to carry it on in the same spirit.

We will bring to the "Index" the facilities of the extensive Engineering Societies Library, the combined library of five great Societies, embracing over eleven hundred leading current engineering publications of all countries, and a reviewing staff of engineers specializing in bringing together the world's technical literature for a single subscription.

We propose to furnish this as an added service to all the members of The Society of Mechanical Engineers.

We accept your offer to assist us by your advice and counsel in taking over the "Index," extending it, and making it the most complete in the world.

Yours truly,

CALVIN W. RICE,
Secretary.

DEAR MR. RICE:

Thank you for your kind favor of the 29th instant, in relation to taking over THE ENGINEERING INDEX.

After having devoted more than 25 years to developing and maintaining that indispensable and priceless publication, I can promise you that engineers and specialists in every state in our Union—and indeed in every quarter of the civilized world—will welcome the glad news that your Society has taken over this great work, and you are now definitely pledged to maintain and extend its invaluable service.

I have always found such ready and widespread appreciation of the INDEX, and especially its Clipping Bureau service, that I have never had any difficulty in making it pay its way—directly for the annual volumes, and indirectly for the monthly issues. Now that the publication will carry the official endorsement of your great Society, and now that you can enlist the active interest of all your members and in addition make an effective appeal for support to members of all the other great engineering societies, I confidently predict that ere long you will find it advisable to issue the INDEX as a separate monthly publication, precisely as we long ago found it necessary to publish it as an Annual.

Wishing you every success in the future development of the work, and assuring you of the cordial and continuous coöperation of myself and every member of our staff, I am,

Sincerely yours,

JOHN R. DUNLAP.

Employment Bureau of the Four Societies

The Society has the pleasure of announcing the establishment of an Employment Bureau under the auspices of the Secretaries of the four National Engineering Societies. This Bureau will have the same personal attention of the Secretary that he has always given to the employment service; and the Bureau will have the advantages which will accrue from the bringing together of the opportunities known to the four Societies.

Particular attention is being given to assisting men just about to leave the Government service or who have already left. The societies feel a special obligation to assist as a patriotic work in this reconstruction service. There will be no charge at the present time, and it is further hoped that in addition to helping members of the Society we may list all engineers who are seeking employment, and give proper references. These references will invariably be investigated, as the Bureau will be conducted solely for the benefit of well-known and reliable firms and thoroughly responsible engineers.

Department of Commerce to Manufacturers

The Department of Commerce is coöperating with American manufacturers in their efforts to study export trade problems. In this connection it has undertaken to investigate the markets for industrial machinery in Asia.

A circular letter has been sent by the Bureau to a number of prominent manufacturers offering them the opportunity to avail themselves of the facilities provided by the Bureau in supplying any desired information. It is stated that the Bureau is prepared to secure information involving any technical or commercial matters even of an intricate nature.

An appeal for donations of tools, machinery and equipment has been issued by the Tuskegee Normal and Industrial Institute for the training of colored young men and women. The Institute suffered a serious loss in the destruction by fire of its Trades Building.

Eightieth Birthday Anniversary of Captain Robert W. Hunt

THE eightieth birthday anniversary of Captain Robert W. Hunt, Past-President Am.Soc.M.E., was celebrated on December 9. Seventeen hundred invitations had been issued to a reception held in his honor at the Mid-Day Club in Chicago, and a large number of his friends availed themselves of the privilege of extending their felicitations to him at that time.

In the evening, the partners and associates in the firm of Robert W. Hunt & Co., with their wives, tendered a dinner to Captain and Mrs. Hunt, and a few of their intimate friends, at the Blackstone Hotel. There were about forty-five in attendance, and each guest received an autographed photograph of Captain Hunt, taken just a few days prior to his eightieth anniversary.

Two important announcements signalized the dinner, the first being a presentation to Captain Hunt by Mr. Samuel T. Wellman of an elaborately prepared testimonial of congratulation and affection, which had been adopted in resolution form by the officers and directors of the American Institute of Mining Engineers. The other event consisted of the announcement of the establishment of a fund guaranteed to be at least $5000, the income of which is to be offered as a prize each year to the author of the best paper on iron or steel subjects presented to the Institute. While the details of the plan have not been fully decided, still it is probable that the prize will be known as the Robert W. Hunt Prize, and the fund and its distribution will of course be managed by the Institute.

Robert Woolston Hunt was born on December 9, 1838, in Fallsington, Bucks County, Pa. His father, Dr. Robert W. Hunt, of Trenton, N. J., was graduated from Princeton College, Class of 1824, and from the University of Pennsylvania. His mother was Martha Lancaster Woolston. He spent several years learning the practical side of iron making in the rolling mills of John Burnish & Co., Pottsville, Pa., and later took a course in analytical chemistry in the laboratory of Booth, Garrett & Blair, upon the completion of which he entered the employ of the Cambria Iron Co., Johnstown, Pa., and for them on August 1, 1860, established the first laboratory in America as a direct part of an iron or steel organization.

In the fall of 1861 Mr. Hunt entered the U. S. Military Service, was in command of Camp Curtin, Harrisburg, Pa., served as mustering officer for the state of Pennsylvania, with the rank of captain, and in 1864 assisted in recruiting Lambert's Independent Mounted Company P. V., and was mustered into the United States service as a sergeant, having tossed up with a friend who had also participated in recruiting the company, as to which one should receive a lieutenant's commission. Upon being mustered out of service he returned to the employ of the Cambria Iron Co., and was sent by them to the experimental Bessemer works at Wyandotte, Mich., of which they were part owners. He was placed in charge of those works in July 1865, and so continued until May 1866, when the Cambria Company called him back to Johnstown to take charge of their steel business, they intending to at once begin the erection of a Bessemer-steel plant. This, however, was not done for several years, and in the meantime, the Cambria Company undertook the rolling of steel rails for the Pennsylvania R.R. Co. from ingots produced by the Pennsylvania Steel Co.'s works at Steelton, Pa., that company's rail mill not being completed. He had charge of the steel for this operation, and these were the first steel rails made in America on a commercial order.

Later Mr. Hunt assisted John Fritz, Cambria's chief engineer, in designing and building their Bessemer works, and assumed charge of it on its completion July 10, 1871, so continuing until August 1873, when he resigned his position. On September 1, 1873, he entered upon the duties of superintendent of the Bessemer works of John A. Griswold & Co., Troy, N. Y. In March 1875 he became general superintendent of the Albany & Rensselaer Iron & Steel Co., which had acquired the works of John A. Griswold & Co. and Erastus Corning & Co. This organization became later the Troy Steel & Iron Co., he remaining in charge until April 1888. During those years he almost completely rebuilt the various works of the company, and also erected a large blast-furnace plant of the most complete character.

Mr. Hunt has taken out several letters patent on steel and iron metallurgical processes and machinery, both individually and in conjunction with John E. Fry, Wm. R. Jones, Dr. August Wendel, and Max M. Suppes. He put in the first automatic rail-mill tables, and later the Hunt-Jones-Suppes rail-mill feed tables were used under licenses by the majority of the rail mills in the United States.

On December 5, 1866, he was married to Miss Eleanor Clark of Ecourse, Mich. In April 1888 he established the Bureau of Inspection, Tests and Consultation of Robert W. Hunt & Co., with principal offices in Chicago, Ill., to which city he removed in the spring of 1888. He served three terms as commander of the John A. Griswold Post No. 338, G. A. R., of Troy, from which office he resigned on removing from that city.

Mr. Hunt is a member of the American Institute of Mining Engineers, and was president of the Institute in 1883, and again in 1906. He was president of The American Society of Mechanical Engineers, in 1890. He is a member of the Western Society of Engineers and was its president in 1893. He is also a member of the American Society of Civil Engineers, Canadian Society of Civil Engineers, the Institute of Civil Engineers, the Institution of Mechanical Engineers, and the Iron and Steel Institute of England. He is a member of the American Society for Testing Materials, and served as its president in 1912. He is the American member of the council of the International Association for Testing Materials.

In 1912 Mr. Hunt was awarded by the John Fritz Medal Committee, representing the American Society of Civil Engineers, the American Institute of Mining Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, the John Fritz Medal, "for his contributions to the early development of the Bessemer process."

Mr. Hunt has contributed many papers to the proceedings of the several societies of which he is a member, and frequently lectures before scientific bodies. He is and has been for many years a trustee of the Rensselaer Polytechnic Institute, Troy, N. Y. In 1916 he received from that institution the honorary degree of Doctor of Engineering.

Mr. Hunt is a member of the Chicago, Chicago Engineers', Mid-Day, Saddle and Cycle, South Shore Country, Illinois Athletic, Glen View, Chicago Golf, Winnetka Country, Montreal Engineers', Engineers' of New York and Mexico City Country Clubs. He has always been interested in outdoor sports and was in his earlier life a cricket and baseball player and is now an enthusiastic golfer.

M. E. C.

A Word from Capt. Hunt

In response to the Society's birthday greetings to Mr. Robert W. Hunt, Past President, Am.Soc.M.E., upon the occasion of his eightieth birthday, the Secretary has received the following note of appreciation:

DEAR SIR:

Permit me, through you, to thank the Council for their highly appreciated birthday expressions, and I beg to assure them that their action did much to add to my happiness on "the day."

With my best assurance of my personal regards to yourself, I remain,

Yours truly,

(Signed) ROBERT W. HUNT.

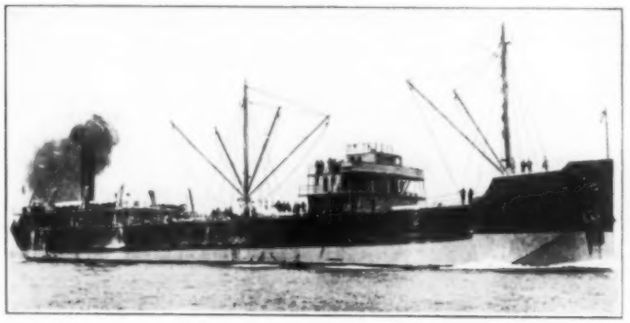
Annual Meeting Excursions

IN arranging for excursions for the Annual Meeting, it was planned to have them occur on two days, Wednesday, December 4 and Friday, December 6. On Wednesday, there were two excursions—a visit to the Hispanic Society at Broadway and 156th Street, in the morning, and in the afternoon a visit to the Brooklyn Navy Yard. A party of about 75 participated in the afternoon excursion, and arrangements were made with the Fifth Avenue Coach Company to furnish two busses, each accommodating 45 persons.

The party was received at the Navy Yard by Rear-Admiral John D. McDonald, U.S.N., and his staff, who accompanied it on the tour of inspection from start to finish. One of the most interesting features of this trip was the inspection of the electric-motor-driven, oil-burning superdreadnought *New Mexico*. Every facility for viewing the features of the work at the Navy Yard was afforded the visitors, who were very appreciative of the courtesies extended.

On Friday morning, about 50 members visited the plant of the Seaboard By-Products Coke Company, Kearny, N. J. The party was met at Summit Avenue by automobiles furnished by the Seaboard Company. This was also an interesting trip.

Over 100 members participated in the inspection of the Concrete steamship *Faith* on Friday afternoon. All the members of the party were permitted to go aboard the steamer which was at the Christopher Street dock.



CONCRETE STEAMSHIP "FAITH"

Upon invitation of Walter S. Finlay, Jr., Mem.Am.Soc.M.E., superintendent of motive power of the Interborough Rapid Transit Company, a number of members visited the 74th Street plant and inspected the new 60,000-kw. turbine.

An invitation was extended to the members to visit the Steel Utilities, Inc., Newark, N. J., at any time during the meeting, for the purpose of inspecting their automatic spacing machine used in fabricating iron and steel.

It was requested that an excursion be arranged to the plants of the Wright-Martin Air Craft Corporation and the Eastern Asiatic Company, but owing to war conditions and other reasons, these plants were not available for inspection.

HARRY J. MARKS, *Chairman*,
Excursions Committee.

Excursion to Aberdeen Proving Ground

MEMBERS of the Society were the guests of the War Department, Engineering Division of the Ordnance Department, Colonel James B. Dillard, Chief, at the Aberdeen Proving Ground, December 13, at probably one of the most complete demonstrations ever given.

At the Annual Meeting, December 5, Coloned Dillard gave an illustrated address of the notable achievements of the Ordnance Department of the United States Army in the production of railway artillery, an account of which is given elsewhere in this number. Many of the guns and rifles of the largest caliber have been completely developed within the period of the war. Following the address, Colonel Dillard invited the members of the Society to the Proving Ground at Aberdeen, midway between Wilmington and Baltimore, where tests were made of guns of all kinds, caterpillar tractors, etc.

The Proving Ground contains about 35,000 acres, is 14 miles long and 6 miles wide. Construction was started Nov. 1, 1917, by 20 officers and enlisted men. A year later there were 301 officers, 4846 enlisted men, 968 civilians and 2500 workmen. In the proof of guns, carriages and ammunition, 6000 to 8000 rounds are fired daily, and the maximum capacity is 12,000 rounds per day, and this would have soon been reached if the war had continued.

Upon arriving at the Proving Ground at 10 a. m., the visitors were first taken to the Trench Warfare Range. The 3-in. and 6-in. Stokes trench mortar was first demonstrated, a total of 240 rounds being fired with 10 mortars, some with an elevation of 75 deg. With the 240-mm. French type of trench mortar 4 rounds of high-explosive shells were fired at 75 deg. elevation, and 4 rounds with the 11-in. Sutton-Armstrong trench mortor; elevation 45 deg., range 2100 yd. Then followed a salvo of 13 rounds with the 8-in. Livens gas projector, at a range of 1850 yd. Finally, 40 shots were fired with some 4-in. Stokes trench mortars, using incendiary shells, American smoke shells, and British heavy smoke shells. The entire demonstration with the roaring guns and smoke barrage was a good imitation of modern warfare.

The party then proceeded to the Main Proof Battery and observed the following guns in action:

37-mm. gun, model 1916; weight 463 lb.; range 2625 yd.; spring and oil recoil system.

75-mm. field gun, model 1897, French, on 1918 carriage; hydro-pneumatic recoil, 47 in. long; weight complete, 2850 lb.; shell 12 lb.; range, 6900 yd. A 1916 model American gun and a 1917 model British gun of the 75-mm. size were also tested.

155-mm. howitzer, model 1918, of Schneider design, and another of Filloux design, were demonstrated, firing a 95-lb. projectile a distance of 10,300 yd. and 19,000 yd. respectively. Total weight, 8200 lb.; hydro-pneumatic recoil; maximum elevation, 42 degrees.

American 4.7-in. field gun, 1906, with oil and spring recoil; shell 45 lb.; maximum elevation, 15 deg. Total weight, 8000 lb.

Bethlehem 6-in. howitzer; hydro-pneumatic recoil; projectile 90 lb.; 13,500 yd.

Vickers, Mark VI, 8-in. howitzer, hydro-pneumatic recoil system; air pressure in recuperator being 700 lb. per sq. in.; recoil 24 to 56 in. long; projectile, 200 lb.; 10,500 yd. Total weight, 10 tons.

Vickers, Mark I and II, 9.2-in. howitzer. Projectile, 290 lb. At 45 deg. elevation, range of Mark II, 12,700 yd.

At this Range are located several constant temperature magazines for the storage of powder, also other buildings in which powder charges for the various guns are made up into their proper weights.

After luncheon an inspection was made of the following artillery tractors of the caterpillar type, designed and built by the Ordnance Department:

75-mm. field gun, 1916, mounted on a standard 2½-ton Ordnance tractor; maximum speed 16.25 miles per hour.
2½-ton special tractor for 3-in. field gun.
5, 10 and 20-ton artillery tractors.
45, 75 and 120-hp. standard Holt artillery tractors.
Mark I special tractor for 8-in. howitzer.

One of the great achievements is the self-propelled howitzer, which went down a ravine at least 10 ft. below the level of the surrounding ground, went up the other embankment and felled a tree 17 in. at the butt, and within a few seconds took position and fired a round of shells.

A Ford armored tank was exhibited, driven by two standard Ford engines. One man maneuvered the tank, the other operated its Marlin anti-aircraft machine gun.

Aeroplanes and hangars attached to the Proving Ground for work in bomb dropping, experimental and proof tests were next inspected. Then the visitors were taken to the Railway Artillery Range, where the following types of railway artillery were inspected and seen in action:

5-in. and 6-in. gun carriages, models 1917, wheel mounts.

7-in. navy gun on model 1918 railway mount; glycerine and spring recoil, 19-in. long; projectile 165 lb.; charge of powder, 57.7 lb.; elevation, 15 deg.; traverse, 360 deg.; range, 17,000 yd.

8-in. Barbette carriage, 1918, for 8-in. seacoast gun, 1888; oil and spring recoil, 48 in. Fires from fixed underframe, laid on road-bed ties, car braced by outriggers; projectile, 200 lb., powder 68 lb.; 20,000 yd.; elevation 42 deg.; traverse 360 deg. Total weight of unit, 173,000 lb.

12-in. seacoast mortar, model 1890 MI, on 1918 carriage and R. R. car. Projectile, 700 lb.; powder 65 lb.; elevation, 65 deg.; traverse, 360 deg. Total weight of unit 174,000 lb.

12-in. gun on sliding mount carriage. Recoil absorbed by whole carriage sliding back 48 in. upon the I-beam under-frame. Total weight of mount, 600,000 lb.

14-in. army gun, model E, on R. R. mount. Recoil, 60 in. long. Fired either from fixed emplacement consisting of special base ring laid in roadbed which allows elevation to 30 deg., or fired directly from track by laying special tracking, which allows 22-deg. elevation. Pro-

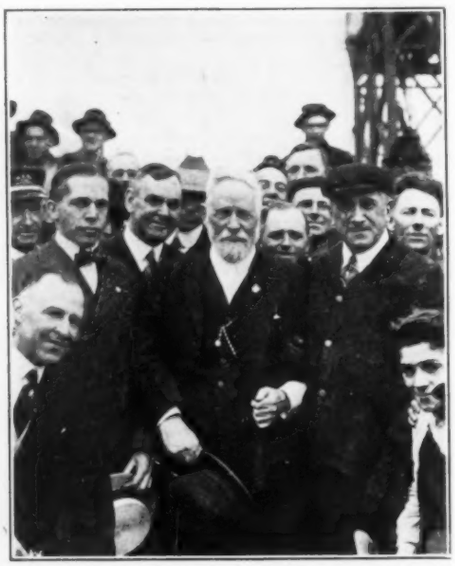
jectile, 1200 lb., powder, 450 lb.; muzzle velocity, 2900 ft. per sec.; maximum range, probably 40,000 yd. Total weight of unit, 400,000 lb.

16-in. howitzer, model E, mounted on 1918 car. Oil and spring recoil, 48 in. long. Fired either from a specially-laid emplacement in the road bed, allowing 65-deg. elevation, or fired direct from track, brakes tightened, car recoiling 25 ft. Engine-driven winch to return car after each shot. Projectile, 1660 lb. Maximum muzzle velocity, 1900 ft.-sec. Maximum range obtained at 45-deg. elevation, 24,000 yd. Total weight of unit, 300,000 lb.

The officers in charge at the Proving Ground were specially thoughtful, explaining every test before it was made. They had a special train for the party, which numbered over 300, and escorted the party back to the railway station for transfer to the main line over the Pennsylvania Railroad. This excursion will long be remembered, not only for the great interest, but also as promoting the pride of every one in the country's achievements.

Valued Portraits

The accompanying snap shot, first published in *The San Franciscan*, was recently sent us by E. C. Jones, Secretary of the San Francisco Section. It gives excellent likenesses of three of the Society's distinguished members, Charles Piez, then Vice-President of the U. S. Shipping Board (at the left); the late



MESSRS. PIEZ, DICKIE AND SCHWAB AT MORSE SHIPBUILDING CO.'S YARDS, OAKLAND, CAL.

George W. Dickie, whose memory will long be cherished by his hosts of friends; and our new Honorary Member, Charles M. Schwab. The photograph was taken several months ago, just after Mr. Schwab had driven the first rivet in a 10,000-ton tanker at the Morse Shipbuilding Company's yards, Oakland, Cal.

American Engineering Standards Committee

AT the present time many bodies are engaged in the formulation of standards. To secure (a) greater uniformity in the rules for procedure in the different organizations, (b) more representative committees engaged in the work, (c) more consideration of all the allied interests, (d) to avoid duplication of work, (e) "standards" proposed for the same thing that differ only slightly from each other often on unimportant details, (f) to anticipate the difficulty of obtaining agreement between the proposers of overlapping standards, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, appointed a committee to consider the advisability of coöperating in Engineering Standardization. As a result of its deliberations this committee recommended that these societies form a permanent organization by appointing a standing committee to carry on this important work, throughout the entire field of engineering standardization.

This recommendation was approved by the five societies and their representatives on the proposed committee appointed. On October 19, 1918 these representatives met and organized as the American Engineering Standards Committee.

The following is the organization of the Committee:

MEMBERS

American Society of Civil Engineers

JOHN H. GREGORY, Consulting Engineer, 170 Broadway, N. Y.
MARTIN SCHREIBER, Chief Engineer, Public Service Railway Co., 80 Park Place, Newark, N. J.
HARRY N. LATEY, Railway Dept., General Electric Co., 30 Church St., New York City.

American Institute of Mining Engineers

GEORGE C. STONE, Chief Engineer, New Jersey Zinc Co., 55 Wall Street, New York City.
JOSEPH W. RICHARDS, Professor of Metallurgy, Lehigh University, South Bethlehem, Pa.
ARTHUR L. WALKER, Professor of Metallurgy, School of Mines, Columbia University, New York City.

American Society of Mechanical Engineers

HENRY HESS, 308 Bailey Building, Philadelphia, Pa.
HENRY H. VAUGHAN, Vice-President, Dominion Bridge Co., Montreal, Quebec, Canada.
WILLIAM F. KIESEL, JR., Asst. Mechanical Engineer, Pennsylvania Railroad, 2320 Broad St., Altoona, Pa.

American Institute of Electrical Engineers

COMFORT A. ADAMS, Lawrence Professor of Engineering, Harvard University. Pres. Am. Ins. El. Engrs.
HARRY M. HOBART, Consulting Engineer, General Electric Co., 10 Morris Ave., Schenectady, N. Y.
NATHANIEL A. CARLE, Chief Engineer, Public Service Electric Company, Newark, N. J.

American Society for Testing Materials

JOHN A. CAPP, Chief of Testing Laboratory, General Electric Co., Schenectady, N. Y.
ALFRED W. GIBBS, Chief Mechanical Engineer, Pennsylvania Railroad Co., Philadelphia, Pa.
A. A. STEVENSON, Vice-President, Standard Steel Works Co., Philadelphia, Pa.

EXECUTIVE OFFICERS

COMFORT A. ADAMS, Chairman, 29 West 39th Street, N. Y. City.
GEORGE C. STONE, Vice-Chairman, 55 Wall Street, New York City.
CLIFFORD B. LEPAGE, Acting Secretary, 29 West 39th St., N. Y. C.

EXECUTIVE COMMITTEE

COMFORT A. ADAMS, GEORGE C. STONE,
HARRY N. LATEY, HENRY HESS,
JOHN A. CAPP.

RESEARCH COMMITTEE

THE following progress reports of the Sub-Committees on Fluid Meters and on Bearing Metals were presented at a meeting of the Research Committee held on December 5, 1918:

REPORT OF THE SUB-COMMITTEE ON FLUID METERS

This sub-committee, formerly known as the Sub-Committee on Flow Meters, has been at work for two years. In 1917, for the winter session, a preliminary report in six sections was prepared for discussion by the members. Discussion and correction was carried on by correspondence, and the report as a whole was revised and the work redistributed at the June meeting at Worcester. The pressure of war work prevented very much active work being done except on Section II, which covers the develop-

ment of suitable formulæ for all of the many types of flow meters.

At the present time Section I, which is an analysis of the problem, has been completed and a classification of all types of flow meters has been made.

The second section, which involves the development of formulæ and suitable constants for the application of these formulae to all conditions for the Pitot Tube, Venturi Tube, the Thin-Disk Orifice, the Thick-Disk Orifice and other similar pressure-developing devices, has been practically completed and will shortly be submitted to the members for final revision.

The sections into which the original report was divided and on which the work is based, will be restated for convenience.

Section I. Analysis of the problem.
Section II. Formulae and constants for the various elementary devices.
Section III. Accuracy and characteristics of the indicating and recording devices as pressure gages.
Section IV. The influence of installation.
Section V. Operating characteristics, cost and desirability.
Section VI. Testing methods.

In view of the situation as developed by the classification of meters under Section I, it appears that the scope of the original Sub-Committee on Steam Flow Meters was undesirably limited. We find that in classifying and examining the features of steam-flow meters, we became necessarily involved in the study of fluid meters as a whole. Upon request to the Research Committee, therefore, the title of this sub-committee has been changed to the Sub-Committee on Fluid Meters.

The general work such as in Sections I, II and III will cover the whole field; but for the present Sections IV, V and VI will concentrate on that group of fluid meters known as flow meters.

The sub-committee has requested an appropriation of $1500. for research to be carried on at two of the college laboratories, in order to check the characteristics of the primary devices with each other and with the previous experimental data. The Research Committee has recommended this appropriation. The object of this sub-committee is to prepare a textbook on the theory and use of fluid meters sufficient for standard reference.

The sub-committee originally consisted only of five members, none of whom were manufacturers. However, about two years ago it became apparent that the best work would be done by inviting the manufacturers to coöperate. To this end representatives have been appointed from the staffs of most of the principal flow-meter manufacturers and they have cordially assisted the remainder of the committee by very effective work. It will probably prove necessary to invite more manufacturers to send representatives for the committee as the work proceeds.

In all probability, another year will see that division of the work applying to flow meters very nearly completed.

SUB-COMMITTEE ON FLUID METERS,
R. J. S. PIGOTT, *Chairman.*

REPORT OF SUB-COMMITTEE ON BEARING METALS

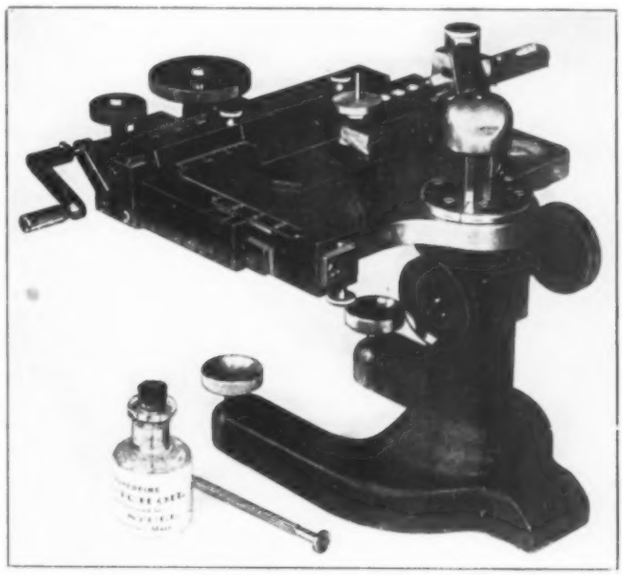
At the time our sub-committee was appointed it seemed wise to first make a complete survey of the existing literature on the subject of bearing metals. This was undertaken by instituting a search in the Engineering Societies Library under the direction of the librarian. A list of references was accordingly supplied to the members of our committee, whereupon independent work was begun with an effort to collate and harmonize the opinions and experiences as presented by the various writers.

Our efforts, however, proved unsuccessful owing to the incomplete, inaccurate and positively contradictory statements that were found upon this subject. We came to the unanimous conclusion that any further efforts in this direction would be hopeless and futile. We thereupon considered the subject of patents; we had a complete search made of the United States patents and made a complete digest of them, together with a search of the English and German patents. All this, however, was equally unsatisfactory owing to the extravagantly optimistic and misleading statements set forth in many of these documents.

For the foregoing reasons our efforts of compiling or collating data on bearing metals have been held in abeyance if not completely abandoned, and during the past year active research work has been done instead.

Microscopic and physical metallurgy has become an exceedingly interesting subject during recent years and this, perhaps, more than any other subject, has a most direct relation with bearing alloys. Recent writers on metallography have disclosed many facts directly bearing upon our subject. Microscopy, chemistry, and metallography give us the number of different crystals, their composition, size and orientation in the various alloys, but the physical property of the respective hardness of these different crystals has never been investigated.

The latter subject, therefore, seemed the most inviting problem and for that reason we have given this our undivided attention during the last year, as far as time permitted. We have now proven conclusively that it is both possible and practical to study



INSTRUMENT FOR USE IN STUDYING HARDNESS OF INDIVIDUAL CRYSTALS

the individual crystals of the bearing alloys with respect to their hardness.

We have perfected an instrument by means of which we are able to pass a very sharp point over the crystals as they are presented on a highly polished surface of the alloy. The great difficulty we encountered was that of finding a suitable substance which could be ground with a sufficiently high degree of accuracy and which at the same time was able to withstand the abrasive action of the harder crystals. We experimented with various grades of steel, the metal tungsten, diamonds, sapphires and tourmaline. We believe we have found an entirely satisfactory material for all requirements in the leuco-sapphire. We have been able to grind this material to a point where we have apparent absolute sharpness with a magnification of 600 diameters.

The shape of point we have found to be most satisfactory is in the form of the corner of a cube mounted in such a manner that the diagonal of the cube is normal to the surface tested, and an edge of the cube directly in the line of motion.

We have been very fortunate in being able to secure from the experimental department of the Spencer Lens Company of this city the necessary highly skilled workmen to do this work. Results so far are very encouraging.

SUB-COMMITTEE ON BEARING METALS,
C. H. BIERBAUM, *Chairman*
J. A. CAPP
H. DIEDERICHS

THE NEW OFFICERS OF THE SOCIETY

President, 1918-1919

MORTIMER E. COOLEY

MORTIMER ELWYN COOLEY, Dean of the Colleges of Engineering and Architecture of the University of Michigan, and President of The American Society of Mechanical Engineers for 1918-19, was born at Canandaigua, N. Y., March 28, 1855.

He graduated from the United States Naval Academy in 1878 and soon after graduation was ordered, with his classmate, Ira N. Hollis, to the U. S. S. *Quinnebaug*, then fitting out at the Norfolk Navy Yard preparatory to a cruise in the Mediterranean. The ship sailed the following December and Cooley spent 15 months on the *Quinnebaug* and then returned to America on the U. S. S. *Alliance*.

During the winter of 1879-80 he had charge of repairs on the *Alliance* at the Norfolk Navy Yard and in the latter year went with the *Alliance* on a cruise to Newfoundland to survey the banks for sunken rocks that had been reported. On the return trip the ship touched at Boston and Norfolk and was headed for the West Indies. At Savannah the young officer was detached and ordered to the Bureau of Steam Engineering, where he remained six months, until July, 1881, in the drafting and design department.

He was then detailed to the University of Michigan for three years under a law which permitted the Secretary of the Navy to detail engineer officers as professors of "Steam Engineering and Iron Shipbuilding," and thus began his long connection with the University which has been his life work and has covered a period of nearly forty years.

It is interesting to note in this connection that mechanical engineering was taught at the University of Michigan as early as 1868, at which time Prof. DeVolson Wood, later of Stevens Institute of Technology, was professor of civil engineering. The prime mover in mechanical engineering was Prof. S. W. Robinson, afterwards at the University of Illinois and Ohio State University. While the curriculum of mechanical engineering has since remained, the degree was abolished in 1870 and not reëstablished until the time of Professor Cooley's administration 11 years later.

One of the first men with whom Mr. Cooley became acquainted in Michigan was Past-President Jesse M. Smith, who had a consulting engineer's office in Detroit. Mr. Smith and Mr. Cooley were the first two college-trained mechanical engineers in the State of Michigan. Mr. Cooley tells of the difficulties in the way of consulting practice in the early days, an instance being the protest of a large lumber company at a bill of 10 dollars a day for services in the direction of economy of fuel, on the ground that there was more fuel then could be burned, anyway, so that there was no need for economy.

After Professor Cooley's detail of three years was ended the regents of the university secured a year's extension of his time; but in 1885 he was ordered to the Pacific Station for duty, whereupon the regents asked him to resign from the Navy to accept the chair of mechanical engineering at the University. This he did and his resignation was accepted December 31, 1885. In the same year the University conferred upon him the honorary degree of M. E. He became Dean of the College of Engineering in February, 1904, and of the College of Architecture in 1913. He received the degree of LL.D. from the Michigan Agricultural College in 1907; and the degree of Eng.D. from the University of Nebraska in 1911.

When Admiral Sampson made his report on the destruction of the *Maine*, at the outbreak of the Spanish-American war, Professor Cooley wired the engineer-in-chief of the Navy, tendering his services. These were accepted and he served during the war as chief engineer of the *Yosemite*, a converted Morgan liner manned by Michigan State Naval Militia.

The *Yosemite* first convoyed a munition ship to Key West and then proceeded to the blockade off Havana. After a single night on this blockade she was ordered to convoy the *Panther* with marines from Havana to Guantanamo, where they were successfully landed, the first American troops to land on Cuban soil. The *Yosemite* was also on blockade duty off Santiago and off San Juan, and for a time off the Jamaica coast to intercept blockade runners. At San Juan she engaged in a five-hour battle with the Spanish forts, gunboats and torpedo boats, as a result of having intercepted a Spanish ship which was putting in with a cargo of munitions. The *Yosemite* fired from 250 to 300 shots and twice drove the gunboats and torpedo boats into the harbor.

During the blockade a serious fire broke out in the coal bunkers of the *Yosemite* which was so deep down in the pile of coal that the crew could not reach it with water from the pumps. Chief Engineer Cooley recalled a method of sinking piles by means of a water pipe attached to the pile, which was used on the Missouri River, and applied it successfully to quench the fire. He used a slice bar along which a hose was triced, with the nozzle near the point, and, with the water discharging through the hose, the bar and hose were easily forced into the coal and the fire extinguished.

Mr. Cooley was attached to the League Island Navy Yard for a time following the war, first as chief engineer in charge of the machinery of a number of ships and then as assistant chief engineer of the yard. After 10 months in the service his discharge was personally handed him by the commandant of the yard with the highest commendation for his efficient work.

Mr. Cooley returned to the University in 1899 and during the years following undertook a large amount of important appraisal work.

A citizens' committee, of which Governor Pingree of Detroit was chairman, appointed to appraise the Detroit street railways, asked Professor Cooley to evaluate the power plants, rolling stock, stores and supplies. This was an urgent piece of work that had to be done quickly. The appointment was made on a Friday, the staff was organized on Saturday and the report made the following Saturday. The value of the property was $2,000,000.

The state legislature of Michigan having ordered an investigation to determine whether an ad valorem basis should be substituted for the specific basis in taxing railroads, Mr. Cooley, in 1890, at the request of Governor Pingree and the State Tax Commissioner, undertook the valuation of the railways and with a force of 150 men completed the field work in 90 days.

This covered 10,000 miles of railway valued at $200,000,000, to which in the process were added the telegraph and telephone lines, plank roads and river improvements.

This investigation led the legislature to adopt the ad valorem basis of taxation which greatly increased the amount of the taxes. The railroads brought suit to enjoin collection and in 1903-4-5 the properties were reappraised under Mr. Cooley's direction at a value for the railways of $240,000,000, an increase of $40,000,000. The state finally won the suit in the U. S. Supreme Court.

In 1902 Mr. Cooley assisted in the appraisal of the mechanical equipment of Newfoundland railways and in 1903 acted as consulting engineer in the Wisconsin railroad appraisal. In 1906 he was a member of the Traction Valuation Committee, Chicago; in 1907 appraised Michigan telephone properties; in charge of appraisal of hydro- and steam-electric properties and railroads for the Michigan Railroad Commission since 1910. The total value of the property with which he has been concerned in appraising is 1¼ to 1½ billion dollars, of which 85 to 90 per cent has been for the public.

Since 1906 he has investigated public utilities in Minneapolis, Milwaukee, Cleveland, St. Louis, Boston, New York, and several other cities.

From 1907 to 1912 he acted as Chairman of the Block Signal and Train Control Board, Interstate Commerce Commission.

In 1893, at the time of the Chicago Exposition, Mr. Cooley was one of the members of the Engineering Committee; also at the time of the Pan American Exposition he was on the Committee of Awards.

For 16 years, 1895-1911, he was senior engineer officer of the Michigan State Naval Militia. Since July last he has been District Educational Director of the 7th District (Illinois, Wisconsin and Michigan) in charge of collegiate training in the Students'

Army Training Corps, organized under the General Staff, U. S. Army.

Mr. Cooley was vice-president of the American Association for the Advancement of Science (1898); director of the American Society of Civil Engineers (1913-1916); vice-president of the Society for the Promotion of Engineering Education (1908-09); president of the Michigan Engineering Society (1903). Also he is a member of various other Societies and Clubs.

He became a member of The American Society of Mechanical Engineers in 1884 and served as Vice-President during the year 1902-03, and in 1916-17 as chairman of the executive committee, Detroit Section.

Vice-Presidents, 1918-1920

FRED R. LOW

Fred R. Low, a Vice-President of the Society for two years, was born at Chelsea, Mass., April 3, 1860, and received his education in the public schools of that city.

He worked as a clerk in the Boston office of the Western Union Telegraph Company, where he learned telegraphing and stenography. He then became stenographer for Thomas Pray, Jr., editor of the *Boston Journal of Commerce*, leaving this position to take charge of the steam engineering section of the paper. He did some indicator work, testing, etc., among the New England mills.

In 1888 Mr. Low became Editor of *Power*, the position which he still holds. In this position he has won distinction not only for the publication itself but as an authority on power-plant subjects and one whose advice is often sought in relation to engineering matters. Last September, the thirtieth anniversary of his editorship was celebrated and Mr. James H. McGraw, the head of the McGraw-Hill organization, publishers of *Power*, said: "*Power* was founded on a great idea; the idea offered a great opportunity for a man to develop it; Fred Low proved to be the happy man and developed the idea into a great publication and at the same time developed himself into a great editor."

In the early days of *Power*, Mr. Low filled a most useful service by lecturing to stationary engineers' organizations throughout the country upon elementary power-plant topics and publishing one of these lectures each month. There can be no doubt but that this work helped greatly to elevate the engineers of many plants in an educational way.

Mr. Low was elected to membership in the Society in 1886 and has served on the following committees of the Society: Publication, Public Relations, Boiler Code, Power Test, Aims and Organization, and is the representative of the Society on the Joint Committee for the Classification of Technical Literature. Mr. Low is the author of books on The Compound Engine, Condensers, The Steam Engine Indicator and also of The Power Catechism.

HENRY B. SARGENT

Henry Bradford Sargent, a manufacturer of New Haven, Conn., was born in New York City, March 4, 1851. His ancestors emigrated from England before 1670, and his family began manufacturing in 1814 at Leicester, Mass.

He graduated in 1871 from Sheffield Scientific School, Yale University and entered the service of Sargent & Company, manufacturers of small hardware and tools, New Haven. He worked his way up in this organization and became assistant superintendent; was elected vice-president of the company in 1887, and soon after became general manager of the extensive works. For many years he was the acting chief executive of the company, and in 1917 he was made president.

For many years Mr. Sargent has been a trustee of Yale University, he is a member of the Yale Engineering Society, the Connecticut Academy of Arts and Sciences, and The Franklin Institute, Philadelphia. He has been a member of this Society since 1898, and was made a member of the Local Sections Committee during the administration of President Hollis. He served for several years on the Committee of the New Haven Section, and as Chairman was active in the organization of the Connecticut Section.

For three years he was a member of the New Haven City Government, and has been director of the Connecticut Manufacturers' Association, director of the largest local bank and a member of various other national and local associations.

JOHN A. STEVENS

John A. Stevens, consulting mechanical engineer of Lowell, Mass., was born at Galva, Ill., in 1868. He was graduated from the East Saginaw High School and studied one year at the University of Michigan. He served a three years' apprenticeship in the machinists' trade with Mitts and Merrill, Saginaw, Mich., after which he was engineer on several of the lake steamers. At the age of 27 he was granted an unlimited engineer's license for ocean steamships.

In 1893 he came East to enter the employ of the International Navigation Company of New York and he served as engineer on board some of their largest ships. On the *St. Paul* of this line, he was first assistant engineer. In 1896 he accepted the position of chief engineer with the Merrimack Mfg. Co., Lowell, Mass., and was very successful in improving the various steam-power installations of this company, making boiler trials, economy tests, etc.

In 1909 he continued this work for the company, but left its employ to go into private consulting engineering practice. He has been granted a number of patents for water-tube steam boilers and superheaters.

He was appointed by Governor Guild in 1907 on the Massachusetts Board of Boiler Rules and after serving three years he was appointed by Governor Draper to serve a similar term. Mr. Stevens became a member of this Society in 1902 and was one of the seven members originally selected to serve on the Society's Committee "to formulate standard specifications for the construction of steam boilers and other pressure vessels and for the care of the same in service," now known as the Boiler Code Committee, and he has served actively on this committee as chairman, continuously since its organization in 1911. He served as one of the Managers of the Society from 1915 to 1918.

Besides membership in this Society, Mr. Stevens is a member of the Society of Naval Architects and Marine Engineers and of the National Association of Cotton Manufacturers. In May 1918 he was presented a medal by the latter association for his paper on the Evolution of the Steam Turbine in the Textile Industry.

Managers, 1918-1921

CHARLES L. NEWCOMB

Charles Leonard Newcomb, a Manager of the Society, was born in West Willington, Conn., August 7, 1854. His early life was divided between working in a glass factory during the winter months and on a farm during the summer months, and he had slight opportunity for attending the district school of the locality.

He was at an early age employed with the Hall Thread Co., South Willington, Conn. Later he was an apprentice in the Murless Foundry and at the Seinor Machine Shop and afterwards was employed as a machinist with the Rock Mfg. Co., Rockville, Conn.

In 1874 he entered the employ of Pratt & Whitney Co., Hartford, Conn. In 1880 he graduated from the Worcester Polytechnic Institute with the degree of B. S. and later was employed as superintendent of the American Electric Light Co., New Britain, Conn., which afterwards became the Thomson-Houston Electric Co. of Lynn, Mass.

In 1881 he entered the employ of Deane Steam Pump Company of Holyoke, Mass., as superintendent, and was made general-manager when the company was acquired in 1899 by the International Steam Pump Company. He continued in the service of this company in the same capacity after it was merged into the Worthington Pump & Machinery Corporation in May 1916.

Mr. Newcomb as a mechanical engineer specialized in steam and hydraulic engineering and has been a very active factor in

the upbuilding of the Deane Works. During his residence in Holyoke, he acted as consulting engineer for various manufacturers of the State, and was employed as an expert in various lines of engineering work. He has been associated with many valuations of plants. Especially of note is the case of the Holyoke Water Power Company, Gas and Electric Branch, which was taken over as a municipal plant by the city of Holyoke.

Mr. Newcomb has been active in the upbuilding of Holyoke and identified with its municipal affairs in various ways. He assisted in organizing the National Founders' Association in January, 1898, and he was elected its first vice-president. He was also a member of a committee of three who drew up the constitution and by-laws adopted by this association. He was also a member of the committee which drew up the constitution and by-laws of the National Metal Trades Association, organized during 1899, and was its first vice-president. He was elected to membership in this Society in 1883.

FRANK O. WELLS

Frank O. Wells was born in Shelburne Falls, Mass., January 6, 1855, and went to school there. In 1874 he entered the employ of the Wiley & Russell Mfg. Co., as a workman and five years later organized with his brother, Frederick E. Wells, the Wells Brothers Company. From this small beginning the firm grew into one of the leading tap and die industries of the country, later merging with the Wiley & Russell Mfg. Co., and forming the present Greenfield Tap & Die Corporation, Greenfield, Mass., of which Mr. Wells is president.

Mr. Wells has been associated with many public interests. He was one of the first to study the problem of making gages and to manufacture them on a war basis. Long before war was declared by the United States he pressed the necessity of the Government's making provision for special tools, gages and fixtures in order that contracts for ammunition might be placed immediately when the need arose.

In 1903 Mr. Wells became a member of the Society. He is on the Society's Committee for the Standardization of Screw Thread Tolerances, and has also been appointed a member of the National Screw Thread Commission as one of the Society's representatives.

CHARLES RUSS RICHARDS

Charles Russ Richards was born at Clarks Hill, Ind., March 23, 1871. He was educated in the public schools of Indiana and at Purdue University, where he received the degree of Bachelor of Mechanical Engineering in 1890, and the degree of Mechanical Engineer in 1891. In 1895 he received the degree of Master of Mechanical Engineering from Cornell University.

While Dean Richards has served in various capacities as a consulting engineer, he has devoted most of his attention to the problems of engineering education.

In 1891 he was instructor in mechanical engineering at the Colorado Agricultural College; in 1892 adjunct professor at the University of Nebraska where he continued as professor of mechanical engineering up to 1911. In 1909 he became the first Dean of the State College of Engineering at this University. In September 1911 he accepted the professorship of mechanical engineering at the University of Illinois, and from June 1913 to September 1915 he served as Acting Dean of the College of Engineering and Director of the Engineering Experiment Station at this University. In March, 1917, after Dean W. F. M. Goss had resigned, Professor Richards was appointed as his successor.

At the University of Illinois, under the general direction of Dean Richards, the work in the college shops has been completely reorganized so that they have been converted into laboratories to provide instruction in the principles of industrial management in the art of manufacturing, to illustrate the effect of the shop processes on the materials of instruction, and to do experimental and research work in connection with the cutting of metals and in the general field of engineering production. It is felt that the methods employed in these laboratories constitute a distinct contribution to the field of engineering education.

Dean Richards has served as consulting engineer in connection with power-plant and water-works problems and the appraisal of public utilities. He has been interested in engineering research relating to fuels, steam engineering, air compression, and gas-power engineering.

He was elected to membership in the Society in 1892. He is chairman of the Bureau of Mines Sub-committee on Fuels which was appointed by the Society, and is a member of the Society's Committee on Local Sections and of the Fuel Division of the Power Test Committee. He is also a representative of this Society on the Engineering Council's Committee on Fuel Conservation, which was appointed to coöperate with the United States Fuel Administration and the Bureau of Mines during the war, and he is a member of the Special War Committee of the Society for the Promotion of Engineering Education and the representative of this Society on the Joint Committee on Engineering Education. He is also a member of the Technical Committee on Coal for Gas, By-Products and Public Utilities appointed by Governor Frank O. Lowden of Illinois, to study problems connected with the utilization of central-western bituminous coal in the manufacture of illuminating gas.

Council Notes

AT the meeting of the Council on December 3, 1918, preceding the 39th Annual Meeting, the following members were present: President Charles T. Main presiding, Spencer Miller, William H. Wiley, *Treasurer*, Ira N. Hollis, John A. Stevens, F. N. Bushnell, James Hartness, R. H. Fernald, Arthur M. Greene, Jr., John A. Brashear, Jesse M. Smith, John Hunter, C. T. Plunkett, D. S. Jacobus, Worcester R. Warner, and the Chairman of the Committees on Administration, George A. Orrok, L. P. Alford, Hosea Webster, Henry Hess, Chairman of the Standardization Committee, Calvin W. Rice, *Secretary*, and by invitation, F. R. Low, representing the Power Test Committee.

SPECIAL ORDERS

Honorary Membership. The Secretary read the report of Tellers on the ballots for Honorary Membership of Charles M. Schwab and Orville Wright, and the President declared them elected.

F. R. Hutton Memorial. Jesse M. Smith, for the Committee on a Memorial to the late Prof. F. R. Hutton, presented a design of plaque by Victor D. Brenner, which was accepted and the committee charged to complete the memorial.

BUSINESS FROM THE PRESIDENT

Fuel Conservation. It was voted to appoint a committee to consider the preservation of the fuel conservation data collected by the U. S. Fuel Administration.

EXECUTIVE COMMITTEE

Paris Engineering Congress. The appointment was made of President Main, to represent the Society at the Engineering Congress called by the Société des Ingénieurs Civils de France, to be held in Paris in December 1918.

STANDING COMMITTEES

Research. An additional appropriation was granted this committee for the use of the Sub-Committees on Flow Meters and Bearing Metals.

SPECIAL COMMITTEES

Aims and Organization. Mr. Alford, representing the Committee on Aims and Organization, reported the resolutions which are published elsewhere in this issue.

War Industries Readjustment. The report of the Chairman of this committee was received.

Administration. This committee was discharged with thanks and its work of administration of the Society's offices placed in the hands of the Finance Committee.

Engineering Resources. In consistency with the action of the Engineering Council, discharging its Committee on American Engineering Service, this committee was discharged with thanks.

Professional Committees

Boiler Code. Upon recommendation of the entire Boiler Code Committee, the publication of the Revised Code was authorized.

The appointment of S. W. Miller on the Sub-Committee on Welding of the Boiler Code Committee was approved, as also was the appointment of John C. McCabe, Chairman, E. C. Fisher and John R. Allen, as a sub-committee to obtain data on the strength of cast-iron sections in boilers.

Power Test Code Committee. The Advisory Board and the Main Committee of the Power Test Code Committee were combined as one Board, and the following sub-committees were approved.

1. General Instructions
2. Definitions and Values
3. Fuels
4. Boilers
5. Steam Engines
6. Steam Turbines
7. Displacement Pumps
8. Centrifugal Pumps
9. Displacement Compressors and Blowers
10. Centrifugal and Turbo-Compressors
11. Complete Steam Power Plants
12. Condenser Units and Feedwater Heaters
13. Refrigerating Machines and Plants
14. Evaporating Apparatus
15. Locomotives
16. Gas Producers
17. Gas and Oil Engines

F. R. Low was appointed Chairman of the Power Test Code Committee.

Refrigeration. The Committee on a Standard Tonnage Basis for Refrigeration was discharged with thanks.

Appointments. Joseph Harrington as a member of the Committee on Feed Water Heaters, John A. Stevens as Acting-Chairman of the Committee on Cost of Electric Power, and C. E. LePage as Honorary Vice-President to represent the Society at the meeting of the Society for Promotion of Engineering Education, Boston, Mass., December 5 and 6.

War Tribute of Engineers. It was voted to appoint a committee to consider a suitable memorial as the Engineers' tribute to those members who lost their lives in the War.

Award of Merit

The establishment of an Order of Merit was approved, and the appointment of a committee to draw up rules and requirements ordered. This Order will be awarded, under vote of the Council, to persons who fulfill the requirements, and who by exceptional genius and accomplishment of engineering results have benefited mankind.

Retirement of the President

The Council gave a rising vote of thanks to the retiring President, Charles T. Main, for his devoted attention to the duties of his office during the past year, together with an expression of the best wishes for a successful and pleasureable outcome both professionally and personally in his trip to France.

Calvin W. Rice,
Secretary.

The first meeting of the Council for the year 1918-1919 was held on adjournment of the Annual Meeting on Friday, December 6, 1918. Present: C. T. Plunkett, retiring Vice-President, who presented the new President, Mortimer E. Cooley, the new Vice-Presidents, F. R. Low, Henry B. Sargent, John A. Stevens; the new Managers, Charles L. Newcomb, F. O. Wells, Charles Russ Richards; others present were Spencer Miller, D. Robert Yarnall, Ira N. Hollis, D. S. Jacobus, Jesse M. Smith, *Chairman Committee on Constitution and By-Laws,* George M. Forrest, *Chairman Finance Committee,* Hosea Webster, *Chairman Membership Committee,* and Calvin W. Rice, *Secretary.*

Special Orders

A cable was sent to Past-President Charles T. Main, en route to France as the representative of the Society at the French Engineering Congress.

President Cooley was asked to represent the Council and convey a message of congratulation to Past-President Robert W. Hunt on the occasion of the celebration of his eightieth birthday.

Standing Committees of Administration

Local Sections. A resolution from the conference of Local Sections delegates assembled at the Annual Meeting, recommending that the Mid-Western Sections participate in the preparation of the professional program for the next Spring Meeting was referred to the Committee on Meetings and Program.

Washington Section. Spencer Miller, Vice-President, and the Secretary were delegated to represent the Council at a get-together meeting of the Washington members on December 9, and to give expression to the appreciation of the Council for the splendid work which Washington engineers had contributed in connection with the war.

Field Secretary. On account of the rapid growth of the Sections movement in the Society, and to provide a close contact between the local sections and headquarters, the appointment of a Field Secretary was authorized.

Standing Committees

Research Committee. Communications concerning (1) research on fatigue of metals, (2) approval of plans of the committee to issue a questionnaire, (3) appropriations for the Sub-Committee on Flow Meters—now designated Fluid Meters and (4) appropriation for the Committee on Bearing Metals, were received and favorable action taken.

Professional Committees

Power Test Code. A. M. Hunt was appointed a member of the Committee, to fill the vacancy caused by the death of Wm. Kent.

Boiler Code. The Council recorded its congratulations and sincere appreciation of the splendid work which has been accomplished by the Boiler Code Committee, and the ever-increasing and far-reaching value of the Code.

Special Committees

Aims and Organization. Resolutions recommending a committee on coöperation of employer and employee were favorably received.

Appointments

I. E. Moultrop was reappointed to represent this Society on the Board of Trustees of United Engineering Society.

W. F. M. Goss was nominated as the representative of this Society on The Engineering Foundation.

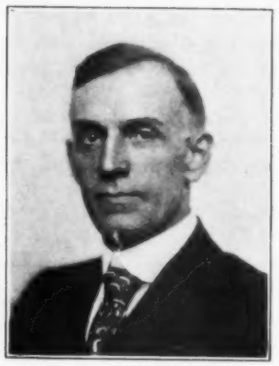
John A. Brashear was elected as the representative of this Society on the John Fritz Medal Board of Award.

Adjournment was taken to meet Friday, January 17, 1919, in New York.

Calvin W. Rice,
Secretary.

R. Gregg
Atlanta

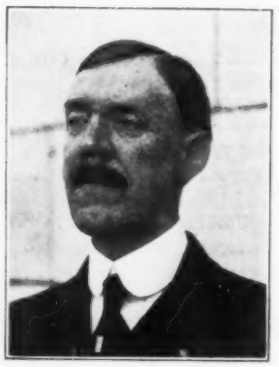
A. E. Walden
Baltimore



W. P. Caine
Birmingham

W. G. Starkweather
Boston

E. L. Fletcher
Bridgeport



H. B. Alverson
Buffalo

C. E. Lord
Chicago

A. S. M. E. LOCAL SECTIONS ORGANIZATION

G. W. Galbraith
Cincinnati

E. S. Carman
Cleveland

Section	When Organized	Number of Members
Atlanta	1913	41
Baltimore	1916	101
Birmingham	1915	45
Boston	1909	514
Buffalo	1915	122
Chicago	1913	496
Cincinnati	1912	160
Cleveland	1918	249
Connecticut	1917	480
Detroit	1916	240
Erie	1917	27

J. A. Norcross
Connecticut and New Haven

E. C. Fisher
Detroit

M. W. Sherwood
Erie

C. S. Blake
Hartford

L. W. Wallace
Indianapolis

C. McGuire
Los Angeles

C. K. Decherd
Meriden

W. M. White
Milwaukee

CHAIRMEN OF EXECUTIVE COMMITTEES 1918-19

J. A. Teach
Minnesota

H. L. Hutson
New Orleans

W. W. Macon
New York

SECTION	WHEN ORGANIZED	NUMBER OF MEMBERS
Indianapolis	1916	83
Los Angeles	1915	69
Milwaukee	1913	107
Minnesota	1913	95
New Orleans	1916	36
New York	1910	2260
Ontario	1917	48
Philadelphia	1912	637
St. Louis	1910	100
San Francisco	1910	143
Worcester	1915	125

R. W. Angus
Ontario

C. N. Lauer
Philadelphia

L. Gustafson
St. Louis

E. C. Jones
San Francisco

H. L. Thompson
Waterbury

E. C. Mayo
Worcester

AMONG THE LOCAL SECTIONS

THE Annual Conference of Local Sections delegates was held in New York on Tuesday, December 3, in connection with the Annual Meeting. All of the twenty-two sections were represented.

The conference was opened by Mr. D. R. Yarnall, *Chairman* of the Committee on Local Sections, who reviewed the annual report of the national committee as published in the December issue of THE JOURNAL. Following this each of the delegates was asked to hand in his written report, and to supplement it by oral remarks. The reports will be summarized in the February issue.

Some valuable observations and suggestions were made in the oral discussion: for example, the delegate from Milwaukee suggested that the Society publish a handbook containing technical data including actions and reports of the various committees of the Society upon standards and standarization, together with the logarithmic tables and other mathematical data.

The member from Baltimore suggested that if the national society submitted to the sections very definite and limited questions for discussion the results would be of great value. There are many subjects of legislation in connection with the education of engineers, ethical standards of engineering, etc., on which such definite questions could be founded.

Chicago suggested coöperation with the New York office in the matter of reëmployment of engineers who come back from the service.

Cleveland and Indianapolis recommended that the mid-western sections be permitted to participate in the preparation for the professional program for the next Spring Meeting, and this recommendation was made the subject of resolutions which were later presented to the Council.

The delegate from Los Angeles reported a plan for the publication of experimental data obtained in several universities in that Section. He suggested that the Society's Research and Standardization Committees outline subjects upon which information was required.

The New York delegate called attention to some of the problems which confront a section of over 2200 members. The largest of these is so to organize the section that the men at large know each other and will attend the meetings. He suggested interchange of meeting notices between sections to invite traveling members to become interested in section activities.

The delegate from Ontario requested information on how to keep up the interest in a small section in a distant place, and said he would like to hear discussion on the things which were found vital and had made meetings a success.

The delegate from St. Louis suggested that standards be outlined showing the sections just what they could do in the matter of members, meetings, papers, research, standardization, etc.

A running account of the written and verbal reports of the delegates is being prepared, and will be mailed out to the Sections and upon request to anyone else interested.

Following the presentation of these reports, the conference took up a discussion of two important matters respecting the Sections Committee—the proposed change in the Constitution providing for the regular Nominating Committee to be elected by the voting membership; and the activities of the national Committee on Increase of Membership. The discussion on the former subject culminated in a resolution to the Council that it was the sense of the Conference that the regular Nominating Committee should be composed of one representative from each Section and seven members at large, to be appointed by the Council. Mr. Jesse M. Smith, *Chairman* of the Constitution and By-Laws Committee, was present during this discussion.

Professor Arthur L. Williston, *Chairman* of the Increase of Membership Committee was present by invitation, and expressed his interest in seeing how universal is the sentiment of confidence in the Local Sections, and the belief that the sections are going to play a larger and more important part in the life of the Society. He thought this was true, without question. He considered that the life and strength of the Society depends on the quality and enthusiasm of the men constantly coming into the organization, and there is no way in which men who have the welfare of the Society at heart can serve it more effectively or permanently than by interesting the right kind of engineers to show the same interest and devotion to the Society that they themselves have.

It seemed to him that the executive committees of the sections and the sub-committees coöperating with them were by far the most important part of the Increase of Membership organization.

A significant note which extended through the whole discussion was the possibility of developing through the Local Sections the relation of the engineer to the community; for example, the delegate from Atlanta called attention to the Engineering Committee in that city appointed each year by the mayor to advise the civic administration on engineering problems. This committee is made up of a representative from each of the four national societies, and the Atlanta Section is represented.

He considered it a departure from ordinary political practice, and undoubtedly a step forward. He said it might mean the recognition of the need and usefulness of engineering ability in the close coöperation with political administration whereby the principle of service may become more and more a tangible reality and less an academic ideal.

"To this end," he concluded, "the membership of the Atlanta Section is constantly striving and we bespeak for ourselves the continuation of the close coöperation and friendly advice on the part of the Local Sections Committee and the membership of the Society."

Washington Section to be Organized

WHAT promises to become an important section of the Society is in process of formation at Washington, D. C. The preliminary meeting for the organization was held at Washington, December 9, 1918, following the Annual Meeting in New York. This was called by a temporary committee consisting of Lieut.-Col. John J. Swan, Major A. D. Blake, George A. Weschler, H. L. Whittemore and Ernest Hartford.

In the afternoon an excursion was arranged to the Bureau of Standards in which about 60 participated. Supper was later enjoyed at Cushman's restaurant, following which there were several addresses, an exhibit and motion pictures of the Browning gun, and a general discussion of the question of the Washington section. A petition to the Council for a local section was signed and the following Local Committee chosen: S. W. Stratton, *Chairman;* George A. Weschler, Secretary; Major J. Henry Klinck, Arthur E. Johnson and Herbert L. Whittemore.

Officials of the Society present were Spencer Miller, Vice-President; William H. Wiley, Treasurer, and Calvin W. Rice, Secretary. Mr. Miller was delegated by the Council to attend as representative and to convey its greetings.

Mr. Rice first spoke, giving practical suggestions from his experience with regard to the organization of a section of the Society. Mr. Miller expressed the pleasure of the Council at the prospect of a Washington section as it was realized how fully the Washington members had contributed to the work of the Government during the war. He said that the war had distinctly shown what a people can do that is bound together with a spirit of righteousness and coöperation, that it can perform miracles if it wants to, and that he hoped that the Washington section would likewise bear splendid fruit in papers that would enrich the Transactions of the Society. He tendered the greetings of the Council and congratulated the section on its large initial attendance.

ARMY RESEARCH WORK

Major O. B. Zimmerman, of the Research and Development Branch of the Army Staff, explained the nature of the work of his branch, covering the supply, purchase and inspection of mobile army equipment, and later imparted some interesting in-

formation regarding the newly-announced substitute for gasoline, named "Liberty Fuel."

Mobile army equipment supplies, said Major Zimmerman, covered that which was used by the engineers in the field of operations.

Equipment and supplies were needed in vast quantities beyond the possibility of using available military equipment and it was therefore necessary to meet the demand by supplying this equipment which was designed and built primarily for commercial needs.

As viewed from the standpoint of the military requirements it was recognized that commercial equipment had certain characteristic deficiencies which were not evident when viewed from peace requirements.

The mention of a few of these characteristics will illustrate the work which naturally fell to the lot of the Research and Development Division and to similar bodies in the Army, where the characteristics were such as to require alterations in order to adapt the apparatus to the needs of the Army, the changes were made with great care so as not to cause too much delay in manufacture.

Portability required great attention to permit frequent and quick changes in location in the field. Much commercial equipment had not received attention from this point of view. Both weight and volume were likewise affected.

Efficiency of motive power was required to the greatest practical extent to avoid carrying unnecessary lubricants and fuels. The majority of appliances in the smaller units were not developed with marked attention to best of materials, efficiency or economy and their commercial ratings were often widely at variance with delivered capacities. Shop test methods were often sadly in need of standardization and Army methods of rating and testing had to be devised.

Enclosure against exposure, while sufficient under normal commercial conditions, was often not sufficient for protection in the field against mud, dust, rain, sun and cold and hence the alterations were necessary to cover these conditions.

These few points will suffice to indicate the general nature of problems connected with equipment serving the purposes of water supply, forestry, road construction, shops, transport, quarrying, crushing, construction, etc.

A considerable group of officers were giving efficient and effective work along these lines and when possible to recount in detail what they accomplished their work will be most gratifying to the engineering profession.

One problem only will emphasize the activities along chemical and physical chemical lines namely that of developing "Liberty Fuel."

Liberty Fuel

This novel fuel consists of over 80 per cent of kerosene, the remainder being chemicals freely obtainable in quantity. This fuel was compounded by officers in the General Engineer Depot, Research Division (which now is operating as a part of the Purchase, Storage and Traffic Division, General Staff) with the object of meeting the anticipated shortage of motor fuel for war purposes planned for the campaign of 1919. The laboratory work on this fuel was completed at the Bureau of Standards. The object was to transform the heavier hydrocarbon oils into lighter ones so that they could be carbureted like gasoline, by a process different from the well-known Burton and Rittman processes. The complete treatment used in the production of "Liberty Fuel" was not to be disclosed until the rights and privileges of the Government and interested individuals were definitely fixed. He said that at the present time the cost of the new fuel should be less than that of gasoline. The process of manufacture was simple and similar to that produced by fractional distillation of native oils. Various grades of oils could be turned out suitable for all types of internal-combustion engines. He said that to Capt. E. C. Weisgerber was due a great deal of the credit for solving the problem by devising a new and independent chemical process. The new fuel had undergone a series of very exhaustive tests in all conceivable types of military and other power engines. The power developed was measured and declared by the Bureau of Standards to be equal in all respects to the results obtained with commercial gasoline. The fuel could be used in any engine built for gasoline or kerosene. The temperature of the engine was lower than with gasoline, which facilitated better lubrication and longer life of the engine.

Although the weight per gallon of the new fuel was greater in the ratio of 7.07 lb. for "Liberty Fuel" against 5.93 lb. for export aviation gasoline, the heat units per gallon were as 124,800 to 112,300 for the gasoline. It was reported that the thermal efficiency was higher in the new fuel, and that the horsepower developed also was greater. Airplanes could remain longer in the air for an equivalent quantity of fuel. Motorcycles showed a marked increase in mileage over that when gasoline was used. Also he said that the superiority of the new fuel was attributed to the lesser heat lost in exhaust and cooling jacket, leaving more heat available for useful transformation into power.

Major Zimmerman thought that this successful solution of the problem of a substitute fuel was an excellent example of the value of coöperation between the War Department and the Bureau of Standards, and that without this valuable assistance the solution of the problem would have been delayed, and he therefore decided to publicly express the thanks of the Department to Dr. Stratton and his able assistants for their coöperation, and his hope that such coöperation would always exist.

Bureau of Standards

Dr. S. W. Stratton, Director of the Bureau of Standards then told the meeting something of the work being done at the Bureau, of its standardization work, of tests being made and specifications written for all sorts of materials used in the industries and by the various Departments of the Government. During the war at least 95 per cent of the Bureau's work had had some connection with military departments. He related how master gages were calibrated by means of light waves, how in spectroscopy plates were stained so as to be more sensitive to the red and longer waves, which plates were very useful in aviation photography. That similar improvements were made in electrical sound ranging. Reference was also made to the airplane motor building that had been erected on the grounds of the Bureau to test the performance of motors under conditions duplicating those of an airplane 25,000 ft. above ground, a 25-ton refrigerating plant being used in this case to cool the air which was at a pressure of only 16 in. of mercury.

Dr. Stratton explained also how the heat resistance of refractories was improved, so that we did not have to depend any longer on the supply from abroad, and were able to make spark plugs that would be durable. The crucibles used in making glass had to be perfected in the same way, with the result that glass parts were finally available at a cost of $9 apiece against $55 for the imported article. That in fact it was believed that these various discoveries in glass manufacture made this country independent of European sources of supply. Another material which was perfected with the assistance of the Bureau was cotton, which was so treated as to take the place of linen in airplane construction, after the supply of linen had become low. In closing Dr. Stratton recalled the pleasant relations established with all military departments, invention boards, etc., and was glad that the Bureau had been able to render services to all departments that had called upon it for scientific assistance.

General Remarks

Major Wiley spoke briefly of the six years which he spent in Congress as one of the few engineers that have been members of that body. He thought Congress did not treat Washington as well as it should, and it did not understand scientific men. He said the Washington Society of Engineers had done good work, and he felt sure that this new Washington section would have an equally brilliant future. That this organization was something they had wanted for a long time, to be able to reach Congress when necessary.

Lieut.-Col. Scrugham reviewed briefly the prominent part taken by members of the A.S.M.E. in the conduct of war operations. He said the machine-tool business had jumped from about 50 millions to 500 millions during the last year and that it was surprising that the Ordnance Department organization stood the strain as well as it did.

Meetings of Sections

ATLANTA SECTION

The Local Section had a very good attendance at its regular monthly meeting held Tuesday, November 26, in the Lecture Room of the Carnegie Library.

The meeting was given over to the discussion of local affairs, and also the organization and possibilities of the proposed American Engineering Society. The members also expressed themselves in regard to the business to come before the meeting of the Committee on Aims and Organization, in order that our delegates would have the benefit of the members' views.

W. J. NEVILLE,
Secretary.

BALTIMORE SECTION

The first fall meeting of the Baltimore Section was held at the Engineers' Club on November 20. The first paper of the evening was read by A. E. Walden, Mem.Am.Soc.M.E., on The Design of Hopper Bottoms for Coal Bins. He stated that he had found in his experience that frequently the cost of bins was unduly high on account of the heavy steel called for in the hopper bottom and its supports. The effect of dropping loads from grab buckets on the hopper bottom was discussed. Mr. Walden then proceeded to analyze the forces present and showed how to determine the stresses in the bottom by graphical methods. The effect of supporting studs and girders was also discussed. The angle of the bottom must be sharp enough to prevent arching. The down spout should be of No. 10 or No. 12 gage iron with vertical seam. Spiral riveted seams retard the coal flow. The bottoms are usually lined with concrete to provide a wearing surface that can be readily renewed. The use of reinforcing plates and angle stiffeners was also discussed.

In the discussion which followed, attention was called to the reinforced concrete bunker of catenary form. One objection to this was the banking of coal between openings.

The second paper of the evening was on Marine Practice in Valves and Piping by A. G. Christie, Mem.Am.Soc.M.E. It consisted of a series of comments on certain marine practices as seen from the viewpoint of a central station man. The effect of various factors on marine practice was noted and a discussion of present practice followed. The author made a strong plea for standardization in marine valves. The use of steel piping on shipboard was also discussed.

In the discussion which followed the following subjects were treated: the expansion of steel bends, the galvanizing of piping and other means of preventing corrosion and also valves for superheat.

A. G. CHRISTIE,
Secretary.

CHICAGO SECTION

The Chicago Section of the A.S.M.E. and the Mechanical Section of the Western Society of Engineers held the first dinner meeting of the season in the Red Room of the Hotel La Salle Friday, December 13. The address of the evening was given by D. L. Derrom, of Winslow Brothers Company, on Shell Manufacture. Mr. Derrom has had extensive experience in munitions manufacture in Canada as well as here, and is a recognized expert on the subject. The address was illustrated with lantern slides showing the processes and with moving pictures of the operations.

A. L. RICE,
Secretary.

CINCINNATI SECTION

A joint meeting of the Cincinnati Section and the Engineers' Club was held in the club rooms on November 21, the subject being A Discussion of the Readjustment of Industries to Peace Conditions.

A. J. Baker, Mem.Am.Soc.M.E., and also a member of the Machine Tool Section of the War Industries Board, opened the discussion by giving some of his experiences as a member of that Board. Mr. Baker also spoke of the tremendous expansion in the building of machine tools in England and stated that the United States would have to expect very strong competition in the building of machine tools from that source. He also gave some of the labor costs in England.

Professor Magee, of the Department of Economics, of the University of Cincinnati, then spoke of the conditions that obtained immediately after the Civil War and contrasted those with the conditions that are likely to obtain from now on.

JOHN T. FAIG,
Secretary.

CLEVELAND SECTION

Our newly-organized Cleveland Section took an important initiative in a special meeting called for Friday, November 29, at the Cleveland Engineering Society rooms, to discuss and recommend a plan whereby the various branches of engineering may be united under one head both nationally and locally.

This suggested plan of coördination has since been received at headquarters and referred to the Council, which voted to invite the Cleveland Section to send three representatives to its meeting in January to present the case to them.

J. H. HERRON,
Secretary.

ERIE SECTION

The Erie Section held a meeting at the Shriners Club on November 25, at which E. J. Armstrong, Mem.Am.Soc.M.E., of the Ball Engine Company, delivered an address on The Glacial History of Lake Erie.

The address treated of the working hypothesis now generally accepted regarding causes of diminished temperature making glacial conditions possible. Three distinct glacial periods of which there is evidence were discussed. Mr. Armstrong pointed out on maps the areas of successive great lake basins and outlets to the ocean prior to the present St. Lawrence River, stating apparent reasons for variations in the size of the gorge cut by the Niagara River and the probable rate of erosion as indicated by United States surveys.

M. W. SHERWOOD,
Chairman.

ONTARIO SECTION

A meeting of the Section was held at the Engineers' Club Friday evening, November 29. An address on The Main Pumping Station of the Toronto Water Works was given by John Milne, Mechanical Engineer, of the Department of Works. The lecture was illustrated by slides of much interest.

C. B. HAMILTON, JR.,
Secretary.

PROVIDENCE ENGINEERING SOCIETY

The Municipal Section held a meeting in the Society's rooms on November 26, at which an address was delivered by Harlow C. Clark of New York, Editor of *Aera*, the official magazine of the American Electric Railway Association.

The subject of the address was The Relation of Electric Street Railways to Municipalities and the Future of Electric Railways.

The Machine Shop Section held a meeting on December 10 which was addressed by George H. North, Superintendent of the Cartridge Case Plant. Mr. North spoke on The Manufacture of Cartridge Cases, describing the tools, equipment and processes. An interesting exhibit illustrating the various operations was shown.

On December 27 the Chemical Section held a meeting in the Society rooms. The speaker of the evening was Walter M. Russell, Superintendent of Manufacturing at the Providence Gas Company, who delivered an address on "Recovery of Light Oil Products at the Providence Gas Company."

W. H. MacKay of the Emergency Fleet Corporation, addressed the Society on December 17, the subject being Marine Engineering and Up-to-Date Methods of Repairing Ships.

W. A. KENNEDY,
Secretary.

SAN FRANCISCO SECTION

The first of a series of meetings planned began with an afternoon meeting at the Engineers' Club on Monday, December 16, where a short paper was read on The Use of Pulverized Coal by M. C. M. Hatch, Chief Engineer of the Locomotive Pulverized Fuel Company of New York.

On December 19 the Section held a meeting at the Engineers' Club, the subject being Why is the Internal Combustion Engine not Used More Extensively for Marine Propulsion?

J. H. Hanson, President of the Scandia Pacific Oil Engine Company, read a short paper on this subject, illustrated by about forty lantern slides, covering the history and development of the Diesel engine, and showing some of the more recent installations on ocean-going vessels.

George A. Dow, President of the Dow Pump & Diesel Engine Company, read a paper on the Diesel Oil Engines on board the Motorship *Libby Maine*.

A paper was also read by Bruce Lloyd, Marine Engineer for the Concrete Ship Section of the Emergency Fleet Corporation, which covered the attitude of ship owners toward the use of the internal combustion engine as power for the propulsion of ships, together with some remarks about the difficulties that have been encountered in the installations which have been under his personal supervision, and also, descriptions of the performances of ships that have been equipped with these engines.

GEORGE L. HURST,
Secretary.

NECROLOGY

DIED IN THE SERVICE

Lawrence H. Bertsch, Captain, Engineering Division, Ordnance Department, U. S. Army.

William J. Plank, Cadet, Air Service, U. S. Army.

WILLIAM SICKLES ACKERMAN

William S. Ackerman, engineer and architect, died on November 11 of heart failure, after a brief illness. He was engaged at the time in the service of the Ordnance Department, U. S. A., as supervising engineer of the Government Carbocoal plant being erected at Russell, near Clinchfield, Va.

Mr. Ackerman was born in November, 1868, in Paterson, N. J. He received his technical education at the Stevens Institute of Technology, where he graduated in 1891, with the degree of M.E. His earlier work was in the West, where he acted as Colorado agent for the Ingersoll-Sargent Drill Co. as draftsman and mechanical engineer for the Standard Smelting and Refining Co. of Durango, Colo., and as assistant superintendent of the Pelican-Dives Mining Company at Silver Plume, Colo. From 1893 to 1897 he was chief engineer of the National Lead Co. He then formed the partnership of Ackerman & Ross, Engineers and Architects, which in 1902, on the retirement of Mr. Ross, became Ackerman & Partridge. The work done by these firms covered nearly every branch of the profession. It included: Carnegie libraries at Washington, D. C., Atlanta, Ga., San Diego, Cal., Port Jervis, N. Y., and Bucknell University, Lewiston, Penn., Engineering and Chemical laboratories at Stevens Institute, etc., court houses, banks, office buildings, schools and factories in

WILLIAM S. ACKERMAN

many states. Perhaps the most notable of these from a scientific standpoint was the Morton Memorial Laboratory at Stevens Institute of Technology. Mr. Ackerman made a special study of the requirements of a chemical laboratory and put forward a design containing so many new and admirable features that it has served as a model for many of the more recent laboratories.

On the dissolution of the firm of Ackerman & Partridge in 1905, Mr. Ackerman went into consulting practice in mill construction and power plants and in 1907 became a member of the Passaic Valley Surveys Commission, which he served in the capacity of secretary, until 1913, when he returned to private practice. In 1916 he went with the O'Rourke Engineering Construction Company as expert in patent litigation. While so engaged he offered his services to the Army Ordnance Department, and by a singular coincidence, died in service at the plant in Virginia on the day the Armistice was declared.

Mr. Ackerman was a member of the New Jersey chapter of the American Institute of Architects, and the Alumni Association of the Stevens Institute of Technology, of which he was president in 1902. He was a former member of the American Institute of Mining Engineers. He became a member of the Society in 1891.

LAWRENCE HOWARD BERTSCH

Lawrence H. Bertsch, Captain in the Engineering Division of the Ordnance Department, U. S. Army, died at the Walter Reid Hospital, Washington, D. C., on Sunday, October 13, after a four-days' illness of influenza followed by pneumonia.

Captain Bertsch was born in Cambridge City, Ind., on October 18, 1879. He attended Earlham College, Richmond, Ind., from 1898 to 1901. In 1902 he received his A. B. degree from Indiana University and the following year entered the University of Michigan, from which he was graduated with the degree of M. E. in 1907. From then until his enlistment in June 1918 in the U. S. Army he was associated with Bertsch & Co., Cambridge City, Ind., manufacturers

LAWRENCE H. BERTSCH

of shears, punches, rolls and presses. He served in various capacities in office and plant, including those of sales manager, superintendent, general manager, chief engineer and finally as vice-president of the company.

He became a member of the Society in 1918. He was also a member of the Engineering Society of Indiana.

EMIL BREZINSKY

Emil Brezinsky was born in New York City on March 4, 1867. He was educated in the public schools of Minneapolis and attended the University of Minnesota. He served his apprenticeship with the Wilford Mfg. Co., Minneapolis. From 1898 to 1907 he was connected with the Allis-Chalmers Co., Milwaukee, as draftsman, and later as chief draftsman on mill construction, power-plant work and in designing and superintending of construction work. He was next associated with the Minneapolis Steel & Machinery Co. in the engine and mechanical department as chief draftsman and assistant engineer; he also designed and developed gas and steam engines, and from 1910 to 1912 was acting chief engineer of the company.

Mr. Brezinsky spent a number of years in Russia representing the Allis-Chalmers Co., and later the International Engineering & Trading Co. At the time of his death in February 1918 he was connected with the Strong-Scott Manufacturing Co., Minneapolis.

Mr. Brezinsky became a member of the Society in 1912.

HAROLD H. HILL

Harold H. Hill was born in 1875, in Detroit, Mich. He was graduated from Cornell University in 1897 with the degree of M. E. His apprenticeship was spent with the Akron, Bedford and Cleveland Railroad Co., Cuyahoga Falls, Ohio. He obtained his drawing-room and shop experience with the American Ball Bearing Co., Cleveland, Ohio. He was next employed by E. H. Jones & Co., Cleveland, as erecting engineer, leaving that firm to represent in Cleveland the B. F. Sturtevant Co., of Boston, Mass.

In 1901 he became associated with the Erie City Iron Works, Cleveland, as mechanical engineer and district sales agent, acting also as contracting engineer. At the time of his death, October 28,

1917, he was holding the position of district sales manager of the company.

Mr. Hill became an associate of the Society in 1904 and a member in 1915.

JOHN S. HUNTER

John S. Hunter was morn in Manchester, Conn., on June 14, 1834. He was educated in Rockville and in the public schools of Pennsylvania. He served his apprenticeship with the Woodruff & Beach Iron Works, Hartford.

For eleven years he was in charge of the Hartford Pumping Station, later becoming a member of the firm of Hunter & Sanford, machinists. Seven years later the Hartford Foundry and Machine Co. was organized and Mr. Hunter was chosen as president. During his connection with the company he built the largest pumping engine in the world, which was installed for the St. Louis Water Works in 1873. For a number of years Mr. Hunter was with the Henry R. Worthington Co., New York, erecting steam pumps for city water works. He was appointed a member of the Board of Water Commissioners of Hartford in 1870 and served three years. By reappointment he became a member of the board again in 1894 and was president from 1895 to 1899. In 1904 he was appointed fire commissioner and served three years.

Mr. Hunter became a member of the Society in 1889. He died on May 7, 1918.

CADET WILLIAM J. PLANK

William J. Plank was born on November 1, 1887, in Jetmore, Kan. He was graduated from the University of Kansas in 1911 with the degree of A. B.; in 1913 he received his M. E. degree and shortly afterwards was appointed through Civil Service to the shops of the mechanical division of the Panama Canal Commission. His duties consisted of general drafting work dealing with construction equipment. He also acted as instructor in mechanical drawing to a class of about thirty apprentices. In April 1916 he was transferred to the planning department of the drafting room.

In the early part of 1918 he enlisted in the Air Service of the Army and was assigned to the School of Military Aeronautics, Austin, Tex., and later transferred to the flying field at Sacramento, Cal.

Cadet Plank died on November 12, 1918, of pneumonia. He became a junior member of the Society in 1916.

GEORG GUSTAV ROHLIG

George G. Rohlig was born on May 7, 1872, in Eisenach, Thuringa, Germany. He came to this country when about sixteen years of age and started work in the Botany Worsted Mills, Passaic, N. J., returning to Europe a few years later. He studied in technical universities at Winterthur and Zurich, Switzerland, and at the Royal Polytechnic High School, Stuttgart, Germany, receiving his engineering degree and thereafter being associated for a period with Leipziger Wollkammerie, Hoboken les Anvers, Succursale, on work having to do with textile machines. His drafting-room experience he gained while with Kammgarnspinnerei, Stoehr & Co., Plagwitz-Leipzig, Germany. He served his apprenticeship in the woolen and worsted mills of Belgium and England, thus laying the foundation of his great technical knowledge in the milling industry.

Upon his return to this country he again became associated with the Botany Worsted Mills as assistant superintendent in charge of the manufacturing. He also assisted in the various enlargements of the mills and since 1903 was director and general superintendent of the company, holding this position at the time of his death, October 29, 1918.

Mr. Rohlig became a member of the Society in 1909.

HORACE MILLIKIN SMITH

Horace M. Smith was born on November 1, 1880, in Terre Haute, Ind., and received his early education there. He was graduated from St. Albans Military Academy and later attended Massachusetts Institute of Technology. He served an apprenticeship with the Niles Tools Works Co., Hamilton, Ohio, as draftsman and also with the American Soda Fountain Co. in the same capacity. In 1904 he became associated with the Liquid Carbonic Co., Chicago, Ill., as a designer and traveling erecting engineer and was advanced rapidly until in 1908 he was given full charge of the iron foundry, the brass foundry and the machine shops. At the time of his death he was chief engineer of the company.

Mr. Smith was an authority on all matters pertaining to the carbonated-drink and bottling industry and the inventor of several devices which have resulted in a practical revolution of that business.

Mr. Smith became a member of the Society in 1913. He died on November 12, 1918.

FLOYD G. TEN BROECK

Floyd G. Ten Broeck was born in Elmira, N. Y., on August 28, 1872, and received his early education in that city. Later he attended Cornell University and was graduated in 1895 with the degree of M. E. His first position was with the Osborn Engineering Co. and dealt with shop engineering. From 1897 to 1899 he was connected with Miliken Brothers and also with R. P. and J. H. Statts, where he obtained his drafting experience. In 1899 he became associated with Westinghouse, Church, Kerr & Co. in the design and erection of mills and power plants, leaving that firm to open private consulting offices in New York City in 1902. For the last sixteen years Mr. Ten Broeck was manager of the engineering department of the West Virginia Pulp & Paper Co., New York.

Mr. Ten Broeck became a member of the Society in 1903. He died on November 1, 1918.

SAMUEL F. TRIPP

Samuel F. Tripp was born in New Bedford, Mass., on November 14, 1866. He was educated in the public schools of New Bedford and later attended the New York evening schools and the Polytechnic Institute of Brooklyn. He also took a course in the International Correspondence Schools of Scranton, Pa.

At the age of eighteen he accompanied his father on a trip to California and while there entered the employ of the Arctic Whale Oil Co., where he worked for two years. His next position was with the Corliss Steam Engine Co., Providence, R. I., as erecting engineer, where he had charge of the installation of engines in the plant of the Waterbury Electric Light Co., Waterbury, Conn., and of repair work on engines in many cities of Rhode Island and Massachusetts. He then entered the employ of the Jones & Laughlin Co., Pittsburgh, Pa., and had charge of the erecting of shafting, being employed for about two years in various mills throughout New England. He was reëmployed by the Corliss Co. and placed in charge of erecting boilers, handling the installation of boilers in Elizabeth, N. J., New York and Baltimore.

In 1891 Mr. Tripp became associated with the Third Avenue Railroad Co., New York, and was put in charge of the erecting of the engines at the Sixty-fifth Street and Bayard Street power stations. In 1901 when the motive power of the Third Avenue System was changed from cable to underground electric the cable power stations were shut down and Mr. Tripp was transferred to the Ninety-sixth Street power station of the Metropolitan Street Railway Co. as engineer in charge. From April 1914 until the Ninety-sixth Street station was discontinued Mr. Tripp in addition to his duties as engineer of that plant was also employed to superintend mechanical construction work at the Seventy-fourth Street power station of the Interborough Rapid Transit Co., having charge of all mechanical equipment in connection with the 30,000-kw. turbines installed in that plant. At the time of his death, September 29, 1918, he was field engineer in charge of mechanical construction connected with the 60,000-kw. turbine now being constructed at Seventy-fourth Street.

Mr. Tripp was a member of the National Society of Stationary Engineers. He became an associate member of the Society in 1915.

PHILIP WALLIS

Philip Wallis was graduated from the Stevens Institute of Technology in 1879. He was first employed by the Clark Bridge Co. as draftsman. His next position was as instructor in mechanical drawing at the Maryland Institute Night School of Design. In the latter part of 1880 he was made assistant in the testing department of the Chicago, Burlington & Quincy Railroad and the following year became engineer of tests in charge of the physical laboratory of that company. In 1886 he became connected with the Long Island Railroad Co. as superintendent of equipment.

Mr. Wallis became a member of the Society in 1886. He died on March 3, 1918.

CHARLES SMITH WHITNEY

Charles S. Whitney was born on August 25, 1881, in North Attleboro, Mass. He received his early education in the public schools of Boston. His technical education he obtained through many years of intensive study by correspondence and through lectures.

He served an apprenticeship of two years with the Holtzer-Cabot Electrical Co., Brookline, Mass., as electrical machinist and draftsman. In 1899 he became assistant to the mechanical superintendent of the Massachusetts General Hospital, Boston. His next position was as construction foreman with the Elektron Manufacturing Co. In 1903 he became associated with the General Accident, Fire and Life Insurance Corporation as elevator inspector, and two years later became senior inspector. In 1912 he was appointed engineer in charge of inspection work and in 1914 became chief engineer in complete charge of all engineering work for the corporation. The following year he was made executive superintendent and at the time of his death, on October 31, 1918, was holding this position.

Mr. Whitney became an associate member of the Society in 1916.

ROLL OF HONOR

At the Annual Meeting was distributed a Roll of Honor of 1397 *names of members in active service in the Great War, corrected to November* 11, 1918, *the date of the signing of the armistice. Since that date additional names have come to hand and are published below, together with those names appearing in the pamphlet but not as yet published in* THE JOURNAL.

ADAMS, JAMES F., Captain, Inspection Division, Ordnance Department, U. S. Army.

AKERLOW, G. W., Captain, Quartermaster Corps, U. S. Army.

BANE, T. H., Colonel, Air Service, Military Aeronautics, U. S. Army.

BAYLIS, R. V., Lieutenant, Ordnance Department, U. S. Army.

BEBOLSHEIMER, H., Second Lieutenant, Field Artillery, U. S. Army.

BLACK, JOHN S., Major, Ordnance Department, U. S. Army.

BLOHM, A. H., Second Lieutenant, Ordnance Department, U. S. Army; assigned to Ordnance Motor Instruction School, Raritan Arsenal, N. J.

BODENSTEIN, W. E., Second Lieutenant, Chemical Warfare Service, U. S. Army.

BRANDT, H. A., Lieutenant (Junior Grade), U. S. Naval Reserve Force.

BRECKENRIDGE, A. L., Chief Machinist's Mate, Mine Filling Depot, Construction Unit, U. S. Navy.

BROOM, B. A., First Lieutenant, Engineers' Corps, U. S. Army; assigned to Co. 7, Engineer Officers' Training School, Camp Humphreys, Va.

BUCKLEY, A. T., Chief Machinist's Mate, U. S. Naval Steam Engineering School, U. S. Naval Auxiliary.

BUTLER, ROLAND G., Second Lieutenant, Field Artillery, U. S. Army.

BUTTERFIELD, THOMAS E., Captain, Coast Artillery, U. S. Army.

CARSE, HERBERT E., Lieutenant, U. S. Naval Reserve Force.

CHERRINGTON, G. H., Major, Ordnance Department, U. S. Army.

CHRISTIE, W. T., Corporal, Engineers' Corps, U. S. Army; Engineer Officers' Training School, Camp Humphreys, Va.

COLLINS, S. W., Private, 322d Aero Squadron, Air Service, U. S. A.

CROSS, W. J., First Lieutenant, Engineers' Corps, U. S. Army; Engineer Officers' Training School, Camp Humphreys, Va.

CUNNINGHAM, F., First Lieuttnant, Quartermaster Corps, U. S. Army.

CUNNINGHAM, JAMES D., Second Lieutenant, Air Service (Production), U. S. Army.

CURTISS, C. R., Captain, Chemical Warfare Service, U. S. Army.

DEW, D. H., Second Lieutenant, Engineers' Corps, U. S. Army; assigned to Engineer Officers' Training School, Camp Humphreys, Va.

DOUGHTY, J. H., Captain, Tank Corps, American Expeditionary Forces, France.

DOWNES, N. W., First Lieutenant, Engineers' Corps, U. S. Army.

ELLIOTT, A. H., Captain, Engineers' Corps, U. S. Army.

FORD, WINTHROP D., Ensign, U. S. Navy; assigned to U. S. S. *Harrisburg*.

FOSTER, ROBERT J., Second Lieutenant, Chemical Warfare Section, U. S. Army.

FRANCIS, HARRIS S., Lieutenant, Ordnance Department, U. S. Army.

FREEMAN, H. S., Chief Machinist's Mate, U. S. Naval Reserve Force.

GLIMM, W. F., JR., Candidate; Engineer Officers' Training School, Camp Humphreys, Va.

GOODSPEED, C. B., Captain, Ordnance Department, American Expeditionary Forces, France.

HAB, HENRY A., JR., Captain, Chemical Warfare Service, U. S. Army.

HARDER, L. F., Captain, Co. C, 302d Engineers, 77th Division, American Expeditionary Forces, France.

HAZELTON, W. S., Captain, Ordnance Department, U. S. Army.

HILL, A. S., Captain, Production Division, Ordnance Department, U. S. Army.

HOLMBERG, A. W., Sergeant, Spruce Production Division, Air Service, Aircraft Production, U. S. Army.

HORN, N. E., Second Lieutenant, Air Service (Aeronautics), U. S. Army.

HOWELL, F. B., Engineering Division, Ordnance Department, U. S. Army.

IMBRIE, W. M., Captain, Engineers' Corps, U. S. Army; assigned to Camp Humphreys, Va.

JOHNSON, A. C., First Lieutenant, Engineering Division, Ordnance Department, U. S. Army.

JOHNSON, J. B., Field Artillery, U. S. Army; assigned to Central Officers' Training School, Camp Taylor, Ky.

JONES, W. T., Private, Coast Artillery Corps, U. S. Army.

KELLER, E. E., Motor truck engine (D); 39 623.

KLOTZ, HARRY J., Second Lieutenant, Air Service, Aeronautics, U. S. Army.

LADD, G. T., Lieutenant-Commander, Bureau of Ordnance, U. S. Naval Reserve Force.

LETELLIER, L. S., Second Lieutenant, Infantry, U. S. Army.

LEWIS, H. I., First Lieutenant, Ordnance Department, U. S. Army.

LOMAX, J. T., First Lieutenant, Chemical Warfare Service, U. S. Army.

LYNCH, THOMAS M., Major, Quartermaster Corps, U. S. Army.

MCLAREN, GEORGE C., Canadian Expeditionary Forces, France.

MATHEWSON, JAMES S., Private, Coast Artillery Training School, Coast Artillery, U. S. Army.

MILLER, A. S., Lieutenant-Colonel, Ordnance Department, U. S. Army.

MONTGOMERY, STAFFORD, Captain, Ordnance Department, U. S. Army.

NEDDERMANN, T. J., Coast Artillery, U. S. Army; stationed at Fort Tilden, N. Y.

ORR, BURTON S., Corporal, Co. 7, Engineer Officers' Training Camp, Engineers' Corps, U. S. Army.

PAINTER, W., Second Lieutenant, Air Service (Aeronautics), U. S. Army.

PRYOR, F. L., Lieutenant-Commander, U. S. Navy.

REDSTROM, E. R., Second Lieutenant, Ordnance Department, American Expeditionary Forces, France.

REED, JAMES, Commander, Construction Corps, U. S. Navy.

RUSTERHOLZ, R. W., Captain, Air Service, American Expeditionary Forces, France.

RYDER, E. R., Sergeant, Meteorological Section, Signal Corps, U. S. Army.

RYDER, M. P., Private, Air Service, Aeronautics, U. S. Army.

SAALFRANK, R. B., Lieutenant, Motor Transport Corps, U. S. Army.

SANBORN, FRANK E., Captain, Sanitary Corps, Medical Department, U. S. Army.

SEARS, H. R., Private, 24th Co., 6th Battalion, 160th Depot Brigade, Infantry, U. S. Army.

SERMULIN, FRED E., Military Specialist Co., American Expeditionary Forces, France.

SHERWOOD, H. P., Second Lieutenant, Chemical Warfare Service, U. S. Army.

SLEFFEL, C. C., Lieutenant, U. S. Naval Reserve Force.

SMITHE, F. B., Second Lieutenant, Heavy Coast Artillery, U. S. Army.

SPRUANCE, W. C., Lieutenant-Colonel, Ordnance Department, U. S. Army.

SWAN, JOHN J., Lieutenant-Colonel, Personnel Branch of the Operations Division, General Staff, U. S. Army.

SYMONDS, RALPH F., First Lieutenant, Tank Section, Ordnance Department, U. S. Army.

TAFEL, T., JR., 3rd Training Detachment, Radio Officers' Training School, Signal Corps, U. S. Army; stationed at Yale University.

TAYLOR, WALTER C., First Lieutenant, 11th Engineers (Railway), General Headquarters, American Expeditionary Forces, France.

TERRIBERRY, G. G., Candidate, Field Artillery Corps, Officers' Training School, 12th Training Battery, Camp Taylor, Ky.

VANDERBILT, CORNELIUS, Brigadier-General, U. S. Army.

VENNEMA, A. W., Second Lieutenant, Chemical Warfare Service, U. S. Army.

WALKER, FRANCIS J., JR., First Lieutenant, Fourth Anti-Aircraft Battalion, American Expeditionary Forces, France.

WALKER, K. G., Second Lieutenant, Air Service, U. S. Army.

WARNER, R. M., First Lieutenant, Ordnance Department, U. S. Army.

WESTWATER, ANDREW, Lieutenant, U. S. Naval Reserve Force.

WEISS, ERWIN A., Sergeant, Engineering Division, Ordnance Department, U. S. Army.

WEISS, LOUIS T., Sergeant, Motor Transport Corps, American Expeditionary Forces, France.

WENZLIK, RICHARD H., U. S. Naval Training Station, Great Lakes, Ill.

WILKE, ERWIN L., Ensign, U. S. Naval Reserve Force; assigned to Naval Experimental Station, New London, Conn.

WILLIAMS, H. J., First Lieutenant, Ordnance Department, U. S. Army.

WILLIAMS, PAUL, First Lieutenant, Inspection Division, Ordnance Department, U. S. Army.

WILLIAMS, SAMUEL C., First Lieutenant, Ordnance Department, American Expeditionary Forces, France.

WILSON, HENRY L., Lieutenant, Quartermaster Corps, American Expeditionary Forces, France.

WITHINGTON, SIDNEY, First Lieutenant, Co. 2, Section B, Engineer Officers' Training Camp, Camp Humphreys, Va.

WORTHINGTON, EDWARD H., First Lieutenant, Army Intelligence School, American Expeditionary Forces, France.

WRIGHT, A. MILES, Candidate, Engineer Officers' Training Camp, Camp Humphreys, Va.

WUERTH, E. A., Private, Field Artillery, U. S. Army; Replacement Depot, Camp Jackson, S. C.

YAGER, JOHN E., Private, Signal Corps, 4th Co., Section B, Students' Army Training Corps, University of Michigan.

YOUNG, C. D., Lieutenant-Colonel, Transportation Corps, U. S. Army.

ZACH, I. M., Candidate, Engineer Officers' Training School, Camp Humphreys, Va.

LIBRARY NOTES AND BOOK REVIEWS

AERO ENGINES, MAGNETOS AND CARBURETORS. By Harold Pollard. The Macmillan Co., New York, 1918. Cloth, 4 x 6 in., 84 pp., 15 illus., 15 pl. $1.

A brief manual, written in simple language and intended for beginners, which makes no pretense to be an exhaustive technical treatment of its subject.

AUTOMOTIVE MAGNETO IGNITION. Its Principle and Application, with Special Reference to Aviation Engines. By Mich. E. Toepel. First edition. Spon and Chamberlain, New York, 1918. Cloth, 4 x 8 in., 103 pp., illus., charts, diags. $2.

Presents the subject in the form of questions and answers covering the general principles of magneto ignition. References to specific types of apparatus have been avoided. Numerous illustrations and wiring diagrams are included.

CENTRAL STATION HEATING. By Byron T. Gifford. Second edition. Heating and Ventilating Magazine Company, New York, 1918. Cloth, 6 x 9 in., 278 pp., 34 illus., tables. $3.

Particular attention has been directed in this edition to the regulations adopted by the various state governments for the control of public utilities, especially to the methods of cost accounting necessitated by rate and valuation investigations. The discussion of high-pressure steam distribution has been expanded and the entire book has been revised.

COAL AND ITS SCIENTIFIC USES. By William A. Bone. (Monographs on Industrial Chemistry.) Longmans, Green and Co., New York, 1918. Cloth, 6 x 9 in., 491 pp., illus., pl., charts, diags., tables. $7.

The author, who was chairman of the British Association Fuel Economy Committee in 1915-17, has tried to give in essential outlines an account of the present state of science and practice in relation to coal and its various uses.

Beginning with an account of the general and scientific aspects of the coal question from a British point of view, there follows a review of the present state of science regarding the origin and chemistry of coal, including its distillation, oxidation and combustion. The latter part of the book considers the principal economic and industrial uses of coal as a fuel, and closes with an account of surface combustion.

The monograph is intended to provide a succinct account of the statistical, chemical and technical aspects of the subject as a whole, without unnecessary details, for use by the scientific public, and especially by that section interested in the chemical side of the subject.

CONVEYANCE AND DISTRIBUTION OF WATER FOR WATER SUPPLY. Aqueducts, Pipe-lines and Distributing Systems. A Practical Treatise for Water-Works Engineers and Superintendents. By Edward Wegmann. D. Van Nostrand Co., New York, 1918. Cloth, 6 x 9 in., 663 pp., 367 illus., 8 pl. $5.

By restricting himself to the conveyance and distribution of water, the author has been able, within the limits of a single volume, to discuss the subject in sufficient detail to be of practical value to engineers and superintendents of water works. Beginning with a chapter on the consumption of water, the flow of water in aqueducts and pipes is next discussed. Then follow chapters on the design and construction of pipes, aqueducts, service reservoirs, stand-pipes and tanks, fire protection and high-pressure systems. The remaining chapters take up maintenance and operation, the cleaning of aqueducts and mains, thawing frozen pipes, leakage, electrolysis, pipe tools and the detection and prevention of water waste.

DAVISON'S TEXTILE BLUE BOOK, UNITED STATES AND CANADA. Cotton, Woolen, Silk, Jute, Flax and Linen Manufacturers; Dyers, Bleachers and Print Works; Commission Merchants; Converters and Brokers; Yarn, Cotton, Waste, Linter Dealers; Mattress Manufacturers; Wool, Rag and Mill Remnant Dealers; Raw, Thrown and Spun Silk Dealers, etc. With a full classified Directory of Cotton and Woolen Mills and a Textile Supply Directory. Thirty-first annual edition, July 1918 to July 1919. Davison Publishing Co., New York (copyright 1918). Cloth, 7 x 9 in., 1471 pp., 7 maps. $5.

This directory covers the textile manufacturers, dyers, bleachers, printers, commission merchants, dealers, and makers of textile mill supplies in the United States and Canada. The various lists are carefully classified for quick reference. The capitalization, officers, equipment, products and railroad connections of each mill are given. Maps showing the location of the textile mills of the country are included.

ELECTRIC WELDING. A Comprehensive Treatise on the Practice of the Various Resistance and Arc-Welding Processes, Covering Descriptions of the Machines and Apparatus Used and the Applications, both in Manufacturing and Repair Work. By Douglas T. Hamilton and Erik Oberg. First edition. The Industrial Press, New York, 1918. 294 pp., 217 illus., 2 tables. $2.50.

A summary of present practice. The authors announce that they have had the assistance of the most prominent American firms engaged in this work, and that they have thus been able to present information on the latest improvements and discoveries.

ENGINEERING DIRECTORY. Buyers' Reference Section. 1918 edition. A Comprehensive Directory of Manufacturers of Mill, Steam, Mine, Plumbing, Heating and Lighting Supplies, Machinery and Tools. The Crawford Publishing Co., Chicago (copyright 1918). Cloth, 8 x 11 in., 566 pp.

This volume contains a list of American manufacturers, trade names and brands of industrial and engineering supplies and machinery, arranged under approximately four thousand subject headings, and a directory of manufacturers. An extensive cross index to the classification is provided.

THE J. E. ALDRED LECTURES OF ENGINEERING PRACTICE, 1917-18. The Johns Hopkins University, Department of Engineering. The Johns Hopkins Press, Baltimore, 1918. Paper, 6 x 9 in., 263 pp., illus., 2 folded pl., 1 map.

A presentation of the tangible and obvious features and principles of present engineering practice, intended to instruct the undergraduate students of the University in every-day working methods of design, construction, and operation.

MAP READING AND TOPOGRAPHICAL SKETCHING. By Edwin R. Stuart. First edition. McGraw-Hill Book Co., Inc., New York, 1918. Cloth, 5 x 8 in., 139 pp., 46 illus., 1 map. $1.

This textbook represents the results of the author's thirteen years of experience in the practice and teaching of topographic surveying and sketching at the United States Military Academy.

PRACTICAL SURVEYING AND FIELD WORK. Including the Mechanical Forms of Office Calculations with Examples Completely Worked Out. By Victor G. Salmon. J. B. Lippincott Co., Philadelphia, 1918. Cloth, 5 x 8 in., 204 pp., 87 illus., 3 folded diag.

The author has endeavored to supply to students a series of calculations which, in connection with well-known textbooks, will equip the young surveyor for the practice of the profession. The work consists mainly of solutions to questions set in examinations for qualification as surveyors in the South African colonies. It is not intended as a textbook, and includes only so much theory as is necessary to explain the examples.

THE RESULT OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS. By Edmond Earle Lincoln. (Hart, Schaffner & Marx Prize Essays, No. 27). Houghton, Mifflin Co., Boston and New York, 1918. Cloth, 5 x 8 in., 484 pp., 14 charts, 1 map, 58 tables. $3.

As a contribution to the discussion on the advantages and disadvantages of public ownership, the author has prepared this impartial, comparative study of results in one well-established business in a specific locality where adequate records covering

a period of years can be secured. The aim of the book is to suggest and exemplify those methods of approach and investigation which may most profitably be followed in future studies of the problems of municipal and state ownership. It is based on a careful, personal statistical study of the annual returns made by the plants to the Massachusetts Board of Gas and Electric Commissioners and a personal survey of the plants themselves.

SCREW PROPELLERS. An Estimation of Power for Propulsion of Ships. Also Airship Propellers. By Rear Admiral Charles W. Dyson, U. S. N. Second edition, rewritten. John Wiley & Sons, Inc., New York, 1918. Cloth, 325 pp., 62 illus., 32 pl., 18 tables, 2 vols. (text and atlas). $7.50.

The first edition of this work on propeller design suffered, the author states, from two serious faults; one being the vagueness of the method for determining the thrust-deduction factor and the other being the method of applying it in determining the characteristics of the propeller. These have both been eliminated to a great degree in this edition and other improvements have been introduced in the text. The author's ideas on cavitation are now fully presented. A chapter on airplane-propeller design has been added.

STEEL SHIPBUILDER'S HANDBOOK. By C. W. Cook. Longmans, Green & Co., New York, 1918. Flexible cloth, 4½ x 7¼ in., 123 pp., 4 folding plates. $1.50 net.

The author, who is associate professor of naval architecture at the University of Southern California, has prepared this convenient pocket-size work for the use of men working in shipyards and for students in shipbuilding classes, the purpose being to acquaint them with the meanings of the terms used in steel ship construction. About 1600 names of parts, tools, operations, trades, abbreviations, etc., are defined, and drawing of some 300 parts are shown on folding plates.

STRUCTURAL SERVICE BOOK. Volume I. A revised Reprint from the 12 Issues for 1917 of the *Journal of the American Institute of Architects*, Structural Service Department. D. Knickerbacker Boyd, Editor. The Journal of the American Institute of Architects, Washington, 1918. Cloth, 9 x 12 in., 226 pp., including Industrial section. $3.50.

The first volume of an annual review of structural activities throughout the United States with particular references to the standards adopted or under consideration by the various societies, associations or other agencies whose work concerns itself in any way with the materials which enter into building construction, the methods and safety of their production, manufacture and erection.

The material is classified and indexed for ready reference. Under each heading are given lists of references to publications giving general information, describing recommended practice and adopted standards.

SEVEN HUNDRED FRENCH TERMS FOR AMERICAN FIELD ARTILLERYMEN. By Edward Bliss Reed, with a Foreword by Lieut. Col. Robert M. Danford. Second edition. Yale University Press, New Haven. Cloth, 4 x 5 in., 66 pp. $0.50.

A brief vest-pocket vocabulary of the French words most frequently used in field artillery.

SHOP MANAGEMENT AND SYSTEMS. A Treatise on the Organization of Machine-Building Plants and the Systematic Methods that Are Essential to Efficient Administration. By Franklin D. Jones and Edward K. Hammond. First edition. The Industrial Press, New York, 1918. Cloth, 6 x 9 in., 307 pp., 159 illus. $2.50.

The purpose of this volume is to give definite information on various systems that have been adopted, particularly in machine-building plants, to insure orderly and effective methods of procedure in the administration of manufacturing, designing and purchasing departments. Concrete examples, rather than theoretical ones, fill the greater part of the book, and show exact details of different systems and their application under various conditions.

SIR WILLIAM RAMSAY. Memorials of His Life and Work. By Sir William A. Tilden. London, 1918. Cloth, 6 x 9 in., 311 pp., 4 pl., 4 por. $4.

Sir William Tilden has written an interesting, readable account of Ramsay's career which does justice to his scientific work and gives at the same time a pleasant picture of the man himself. He has had the advantage of Lady Ramsay's coöperation, and has made use of the letters preserved by her and other members of the family.

STEEL SHIPBUILDERS' HANDBOOK. An Encyclopedia of the Names of Parts, Tools, Operations, Trades, Abbreviations, etc., used in the Building of Steel Ships. By C. W. Cook. Longmans, Green and Co., New York, 1918. Flexible cloth, 5 x 7 in., 123 pp., 4 folded plates. $1.50.

This handbook is intended to help the men now obtaining employment in shipyards to understand the unfamiliar terminology and processes of steel ship building. It gives, in a compact volume of pocket size, an alphabetical list of definitions of some 1600 names, and plates illustrating about 300 parts of steel ships. The definitions have been collected from standard textbooks and a study of the methods now used in American shipyards.

STUDIES ON SOLUTION IN ITS RELATION TO LIGHT ABSORPTION, CONDUCTIVITY, VISCOSITY, AND HYDROLYSIS. A Report Upon a Number of Experimental Investigations Carried Out in the Laboratory of the Late Professor Harry C. Jones. Compiled by Paul B. Davis. Carnegie Institute, Washington, D. C., 1918. Paper, 7 x 10 in., 144 pp., 25 illus., 116 tables. $2.

The report represents the various lines of investigation pursued under Professor Jones's direction during 1915-16, all having some bearing upon the conceptions of solution in general and of solution in particular which have been developed by that laboratory.

THE SUBMARINE IN WAR AND PEACE. Its Developments and Its Possibilities. By Simon Lake. J. B. Lippincott Co., Philadelphia. 1918. Cloth, 6 x 9 in., 302 pp., 18 illus, 53 pl., 1 portrait, 1 map, 1 folded diag. $3.

Mr. Lake's endeavor has been to provide an interesting popular account of the mechanical principles of the submarine, the history of its development, its actual operation, the difficulty of combating it and its industrial possibilities.

VACUUM TUBES IN WIRELESS COMMUNICATION. A Practical Textbook for Operators and Experimenters. By Elmer E. Bucher. Wireless Press, Inc., New York (copyright, 1918). Cloth, 6 x 9 in., 174 pp., 219 illus. $1.75.

The author explains over 100 different circuits for the practical use of vacuum tubes, which have been used from time to time in the laboratory and commercial practice, and gives a brief and simple explanation of the manner in which vacuum-tube circuits act.

WATERWORKS HANDBOOK. Compiled by Alfred Douglas Flinn, Robert Spurr Weston and Clinton Lathrop Bogert. Second edition. McGraw-Hill Book Co., Inc., New York, 1918. Flexible cloth, 6 x 9 in., 824 pp., 411 illus., 313 tables. $6.

The new edition of this compilation of information for designers and operators of waterworks differs only in minor matters from the first one, published in 1916. All errors which have been found have been corrected, some small additions of new material have been made and a few portions have been rewritten to utilize recent information.

THE ZINC INDUSTRY. By Ernest A. Smith. Longmans, Green and Co., New York, 1918. Cloth, 6 x 9 in., 223 pp., illus., 2 diag., 4 pl., 1 map., tables. $3.50.

The author of this volume of the series of Monographs on Industrial Chemistry has written a general survey of the development of the zinc industry and its present and possible future position in relation to the various metal industries of Great Britain. The rise and progress of the industry, the new materials and their sources, marketing of ores and metal, smelting, physical and chemical properties, industrial applications and alloys are considered, and a bibliography of the more important publications is appended.

Library Accessions

AMERICAN SOCIETY FOR TESTING MATERIALS. A.S.T.M. Standards, 1918. *Philadelphia, 1918.* Purchase.

ARCHIVES DES SCIENCES PHYSIQUES ER NATURELLES. Tables générales des Auteurs et des Matières. 1879-1910. *Geneve, 1917.* Purchase.

CARBOLIC ACID AND ITS PRODUCTION FROM BENZOL. By Geo. H. Stevens. *Newark, 1916.* Gift of author.

CHEMISTRY OF PHOTOGRAPHY. By Raphael Meldola. *London, 1891.* Gift of Samuel Wein.

CLEANING AND ELECTRO-PLATING OF METALS. By H. H. Reama. *New York, 1917.* Gift of Samuel Wein.

CUTTING LUBRICANTS AND COOLING LIQUIDS AND ON SKIN DISEASES PRODUCED BY LUBRICANTS. Memorandum. *London, 1918.* Gift of Great Britain. Department of Scientific and Industrial Research.

EDUCATION OF MINE EMPLOYEES. By H. H. Stoek. (Illinois Miners' and Mechanics' Institutes. Bulletin No. 1.) *Urbana, 1917.* Gift of A. D. Flinn.

EFFICIENCY IN THE USE OF OIL FUEL. A handbook for boiler plant and locomotive engineers. *Washington, 1918.* Gift of Bureau of Mines.

ENGLISH CATALOGUE OF BOOKS, 1917. *London, 1918.* Purchase.

FEDERAL VALUATION OF THE RAILROADS IN THE UNITED STATES. Statement prepared by Thomas W. Hulme, vice-chairman, of the Developments in connection with Federal Valuation as of Sept. 20, 1918. Gift of Clemens Herschel.

LIST OF INSPECTED MECHANICAL APPLIANCES, July 1918. *Chicago, 1918.* Exchange.

ARTHUR D. LITTLE COMPANY, INDUSTRIAL RESEARCH LABORATORIES. Descriptive booklet. *Cambridge, 1918.* Gift of company.

MCGRAW ELECTRIC RAILWAY LIST, August 1918. *New York, 1918.* Purchase.

MEMORIAL OF AMOS P. BROWN. By R. A. F. Penrose, Jr. (Reprinted from the *Bulletin of the Geological Society of America*, v. 29, pp. 13-17, 1918.) Gift of author.

OIL AND PETROLEUM MANUAL FOR 1918. By Walter R. Skinner. *London, 1918.* Purchase.

ORGANIZATION OF WAR TRANSPORTATION CONTROL. Railroad Committee, Chamber of Commerce of the United States. *Washington, D. C., 1918.* Gift of Railroad Committee.

PRINCIPLES OF MECHANICS. Ed. 4. *London, 1794.* Gift of Charles Macdonald.

TRADE CATALOGUES

COPPUS ENGINEERING & EQUIPMENT COMPANY. Worcester, Mass. Turbo Blower for undergrate draft and other industrial purposes. Descriptive booklet.

FELLOWS GEAR SHAPER COMPANY. Springfield, Vermont. Internal Gear, design and operation. Descriptive catalogue, 1918.

GEM STOPPER COMPANY. Philadelphia, Pa. Bulletin No. 8. Universal acid carboy stoppers, asbestos gaskets and metal fasteners. 1918.

GENERAL FIRE EXTINGUISHER CO. Providence, R. I. The Grinnell Sypho chemical sprinkler system. Descriptive booklet. 1917.

HIRES TURNER GLASS COMPANY. Philadelphia, Pa. Bulletin No. 2. Wire Glass and Why.

JEFFREY MFG. CO. Columbus, Ohio. Bulletin no. 246. Jeffrey Pit car loader.

JONES & LAMSON MACHINE COMPANY. Springfield, Vt. The Fay automatic lathe; a machine for the automatic turning of work held on centers or on centered arbors. 1918.

LUITWIELER PUMPING ENGINE CO. Rochester, N. Y. Illustrations and descriptions of nonpulsating power pumps.

SYPHO CHEMICAL SPRINKLER CORPORATION. New York, N. Y. The combination of a system and a service. 1916.
——— Service of Protection. 1916.

PERSONALS

IN these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by January 15 in order to appear in the February issue.

CHANGES OF POSITION

JAMES P. CALDERWOOD, formerly associated with the engineering and inspection division of the Travelers Insurance Company, Hartford, Conn., has become professor of gas and steam engineering, The Kansas State Agricultural College, Manhattan, Kan.

CHARLES H. STODDARD has severed his connection with the Moore Shipbuilding Company, of Oakland, Cal., of which he was chief engineer, and has accepted the position of consulting marine engineer with the Heine Safety Boiler Company, Phoenixville, Pa.

AUGUST ULMANN, JR., until recently associated with Walter Kidde and Company, Philadelphia, Pa., in the capacity of construction engineer, has assumed the duties of power engineer with the National Aniline and Chemical Company, Marcus Hook, Pa.

FRED E. ROGERS, JR., formerly with the J. G. White Company, New York, has accepted the position of sales engineer with the Fafnir Bearing Company.

A. E. NORRMAN, formerly professor at the Technical University, Helsingsfors, Finland, has recently accepted a position as engineer with the F. W. Horne Company in Tokyo, Japan, importers of American machinery.

C. H. BEAN has resigned as assistant superintendent of motive power of Armour and Company, and has accepted a position as chemical engineer on the advisory board of the Calco Chemical Company, Bound Brook, N. J.

CHARLES W. E. CLARKE has become associated with Dwight P. Robinson and Company, Inc., constructing and consulting engineers, who have recently opened offices at 61 Broadway, New York. Mr. Clarke was formerly affiliated with the Stone and Webster Engineering Corporation, Boston, Mass.

C. T. Henderson has resigned as chief engineer of the Submarine Boat Corporation, Port Newark Terminal, Newark, N. J., and has become identified with the Hercules Engineering Corporation, New York, as its chief engineer, also acting as president of the Electrolytic Engineering Corporation at the same address.

O. C. BORNHOLT, formerly factory manager, Holley Brothers Company, Detroit, Mich., has become mechanical engineer of the Buick Motor Company, Flint, Mich.

JOHN J. EYRE has resigned his position with the Worthington Pump and Machinery Corporation, to accept the position of factory engineer with the Sturtevant Aeroplane Company, Boston, Mass.

BYRON T. MOTTINGER has severed his connection as general superintendent of power at the Fort Dodge, Des Moines and Southern Railroad, Boone, Ia., to become associated as chief engineer and master mechanic with the Quaker City Rubber Company, Wissinoming, Philadelphia, Pa.

ANNOUNCEMENTS

M. WILLIAM EHRLICH, after ten months' service at the U. S. Government Explosives Plant, Nitro, W. Va., as engineer on progress for the Thompson-Starrett Company, has become associated with the George H. Gibson Company, New York, engineering and editorial specialists.

C. W. KOINER is engaged in war work at the United States Shipping Board, Emergency Fleet Corporation in the Power Section, Division of Shipyard Plants.

JOHN R. FREEMAN, Past-President, Am.Soc. M.E., has resigned as president of the Providence Gas Company, effective January 1, in order that he may be free for another trip to China, where he will supervise surveys and plans for the modernizing of the Grand Canal.

H. B. VIEDT has received a commission as Ensign, U. S. N. R. F., to be assigned for engineering duties only.

EDWIN L. KING has been elected secretary-treasurer of the Pratt and Cady Company, Hartford, Conn. He succeeds to the treasurership of the late Bishop White and retains the position of secretary.

LIEUT.-COLONEL THOS. B. WHITTED has recently been released from duty with the United States Army. Colonel Whitted, then a Captain in the E. O. R. C., was called to the colors in April 1917 and after a few weeks was ordered to duty with the American Expeditionary Forces, and for nearly a year was in immediate charge of all purchases for the Corps of Engineers in France. He was rewarded with a Majority for this work, and at his own request was sent to front line duty with troops, from which he was relieved in July 1918, promoted to Lieutenant-Colonel and ordered to the United States to bring over a new Regiment of Sappers.

APPOINTMENTS

ALBERT M. BROWN has been appointed district manager of sales, Philadelphia, Pa., of the Chicago Pneumatic Company. Mr. Brown has been located in the New York offices of the company as assistant manager of the compressor sales division.

GERSHOM SMITH, formerly comptroller of the Pennsylvania Steel Company, and more recently vice-president of the Tabulating Machine Company, after seven months in the office of the Quartermaster-General at Washington, has been appointed consulting accountant in the engineering firm of George W. Goethals and Company, Inc., New York.

H. DE B. PARSONS has been appointed civilian engineer, Aircraft Production, Approvals Department, U. S. A.

HAROLD C. WHITE has been appointed factory manager of The Harris Manufacturing Company, of Stockton, Cal. During the last three years Mr. White has been actively engaged in the reorganization of the plants of the Holt Manufacturing Company, of Stockton, Cal., and at Peoria, Ill.

AUTHORS

LIEUT.-COLONEL E. C. PECK, Engineering Bureau, Ordnance Department, has contributed an article on Types of Reamers and Their Use to the December issue of *Machinery*.

E. A. UEHLING is the author of an article entitled Combustion in Its Relation to Boilers, in the December 3 number of *Power*.

EMPLOYMENT BULLETIN

THE SECRETARY considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping any one desiring engineering services. The Society acts only as a clearing house in these matters.

POSITIONS AVAILABLE

Stamps should be inclosed for transmittal of applications to advertisers; non-members must accompany applications with a letter of reference or introduction from a member; such reference letter will be filed with the Society records.

PRODUCTION, PLANNING AND SCHEDULING ENGINEERS, to act as assistant shop superintendents in Hull Division. Salary to start $6.00 per day. Location, New York. A-0513.

SALES ENGINEER, young, with experience in power-plant equipment. Technical graduate preferred. Excellent prospects. Location, Philadelphia, Pa. A-0524.

ASSISTANT TO DIRECTOR, Engineering Experiment Station. Some practical editorial experience required; initiative and ability to carry out work with minimum supervision. Salary dependng largely upon age, experience and training of man. A-0558.

SUPERINTENDENT, for barrel-manufacturing division. Absolutely essential to have had experience on barrels of light-gage steel, also on oxy-acetylene. Splendid opportunity for right man. Location, Massachusetts. A-0579.

U. S. NAVY STEAM ENGINEERING SCHOOL: U. S. Navy Department has perfected plans for the enrollment and training of considerable numbers of engineering officers. A school for this purpose, the U. S. Navy Steam Engineering School, has been established by the Department at Hoboken, N. J. Open to men between the ages of 21 and 40 who meet the physical requirements of the Navy, thorough ability and officer-like character and who have completed the mechanical or electrical engineering course at certain recognized technical schools, or who possess an education and experience judged to be an equivalent thereof. Enrollment men properly qualified may be made at any Naval Enrolling office, notation being made of the applicant's qualifications and desire to be detailed to this school. Men already in the Naval Service and properly qualified should apply for admission to the course to the Commanding Officer. Enroll at any naval enrolling office. For information write Assistant to District Enrolling Officer, 102, New Orleans, La. A-0660.

MECHANICAL ENGINEER, with good record, thoroughly experienced in design of high-grade steam engines and boilers, particularly of the marine type; able to handle draftsmen. Give age, experience in detail, salary desired. Location, Pennsylvania. A-0838.

CHIEF ENGINEER, familiar with design of structural and plate work, hoisting and conveying machinery of the heaviest type. Must have executive ability of the highest order. Give age, experience in detail and salary wanted. Location, Pennsylvania. A-0839.

MECHANICAL ENGINEER, to take charge of engineering office of chemical plant. State qualifications and salary desired. Location, New Jersey. A-0840.

MEN, young, to assist master mechanic of rolling mills. Would like men with technical education but not absolutely essential. Work necessitates knowledge of industrial plant equipment; preferably steel-mill equipment. Future prospects good. Give complete history of experience and salary expected. A-0842.

SALESMAN, to handle line of rotary, centrifugal and force pumps, selling to jobbing trade. State fully experience and qualifications, will be treated confidentially. Engagement first of the year. Location, Buffalo, N. Y. A-0847.

MAN, between ages of 30 and 40, with successful experience as an industrial executive; who anticipates the trend of industrial developments, including material markets, labor conditions, management methods, domestic sales opportunities in new fields, etc. One familiar with metal-stamping industry preferred. Good opportunity for right man. Reply by letter, giving age, education in detail, married or single, experience, present and expected salary. A-0848.

CHIEF ENGINEER, American, good education, practical experience, unimpeachable character and exceptional ability, with mature judgment and good personality. Must have executive as well as constructive capacity. Will be required to assume control of engineering department in manufacture of precision machine tools, keep in touch with the demands of customers and the output of competitors, so far as matters of design are concerned. Mere inventor cannot fill the requirements. Position will be made attractive to right man. If in a big position already, will not interfere with plans. Location, New England. A-0849.

DRAFTSMAN AND TRACER, on ship and yacht hull work. Two men for office of naval architects and marine engineers. Preferably men with previous experience along these lines. Location, New York. A-0850.

INSTRUCTOR in mechanical engineering for Southern University, to teach shop-work and drawing, possibly mechanism. Salary $1,600 per year. In reply state age, education, experience, photograph and copies of letters of recommendation. A-0851.

ORGANIZING ENGINEER, young, for high-grade time study and intensive management work. Broad and expanding field for able man, large rubber factory. Location, Ohio. A-0852.

MECHANICAL DRAFTSMAN, by old established concern in small town. Living conditions excellent. Permanent position to right party. Give full information in first letter. A-0853.

INSTRUCTOR in mechanical engineering. Technical graduate with both teaching and practical experience. Give complete statement of qualifications, late photograph, height and weight. Salary $1,500 to $2,000. Location, District of Columbia. A-0854.

MECHANICAL ENGINEER, progressive; familiar with the engineering and operating of briquetting plants. A-0857.

DRAFTSMAN, first class on power-station design. Location, Providence, R. I. A-0858.

DISTRICT REPRESENTATIVE AND SALES ENGINEER, familiar and in touch with power-plant installations, furnace construction and general engineering products in Cleveland, Detroit and Cincinnati. Must be engineer of good standing, having sales ability and wide acquaintance in the engineering profession. Headquarters, New York. A-0859.

MAN, technically trained, to take charge of industrial furnace department for company manufacturing oil and gas-burning furnaces, used for tempering tools and steel, also for forging. A man big enough to take complete charge and direct the designing, development work, planning, estimating, and sales engineering of this department. Need technical man to handle propositions for specifications and estimates. Location Massachusetts. A-0860.

SUPERINTENDENT, for well-organized plant manufacturing high-grade printing machinery. Must be experienced executive and thoroughly versed in modern methods of interchangeable manufacturing. Give age, nationality, experience and salary expected. Location, near New York. A-0862.

MEN, young, educated in mechanical lines, particularly with a knowledge of internal-combustion engines, to develop into sales engineers. Location New York. A-0863.

WORKS ENGINEER, and maintenance of machinery operation of steam. Electric power-plant construction and maintenance of building and equipment. Permanent position with old-established concern. Location, Corning, New York. A-0864.

PRODUCTION AND PLANNING ENGINEER. Salary from $3,000 to $4,000, depending upon the ability of the applicant. A-0867.

SALES ENGINEER. Preferably one with technical education, but must have full knowledge of power-plant practice. Oldest and largest concern manufacturing high-grade power-plant equipment requires two additional men in the field. State last position held, giving full details and minimum salary to start. A-0868.

MECHANICAL DRAFTSMAN, with technical training or equivalent. Experienced in layout and detail of combined mechanical and structural work, able to handle machinery on cranes, conveyors, swing bridges or sluice gates, etc. Must be thoroughly capable, able to work without constant supervision, and to produce results quickly. A-0869.

ASSISTANT FOREMAN, for maintenance department. Young man just out of college or a mechanical engineering graduate with slight experience, large manufacturing company. Location, New England. A-0870.

DESIGNING ENGINEER, for large industrial plant, building excavating machinery. Prefer technical graduate with experience on similar class of work. Salary dependent on ability of man. Location middle-west. A-0872.

DRAFTSMAN AND DETAILERS, for industrial plant lay-out work, preferably men with experience in elevating and conveying machinery. State age, education, nationality, previous experience and salary desired. A-0873.

MECHANICAL DRAFTSMAN, with from one to three years' experience on designing of machine tools, jigs and fixtures. Technical graduate preferred. Salary depending upon ability and experience. Excellent opportunity for right man. Location, Connecticut. A-0874.

DESIGNING MECHANICAL ENGINEER, thoroughly experienced in coal and ore-handling equipments; shipbuilding and wharf cranes; conveying machinery, etc. High-grade technical man wanted to take charge of design. State education, nationality, salary desired. Information confidential. Location, Canada. A-0876.

ENGINEER, with some experience in the thermodynamic design and calculation of steam turbines. Prefer young, capable man, to work into responsible position. A-0877.

MAN, of wide experience in same line as No. 0877. A-0878.

ENGINEER of good executive ability and some experience on steam turbines, to handle a variety of work under direction of the chief engineer. A-0879.

STEAM TURBINE DRAFTSMAN, capable of doing development and improvement work. Give full information as to training and experience. Location New England. A-0880.

DESIGNING ENGINEER, experienced on high-pressure steam engines of the poppet valve and kindred types. Location, St. Louis. A-0882.

MECHANICAL ENGINEER, for field work. Must have technical training, preferably college graduate with at least 10 years' experience in construction and operation of power-plant machinery, including steam engines, steam and hydraulic turbines and internal-combustion engines. Preference given to practical man

with sales experience and wide knowledge of industrial plant equipment gained through operation or inspection work. Give age, training and experience. Salary $2,000 to $3,000. Apply by letter. A-0883.

TECHNICAL WRITER, preferably former assistant editor on engineering publication, or instructor in college of mechanical engineering. Should have ability to make technical subjects clear to non-technical readers. Knowledge of a wide variety of machinery, its construction and operation, through extensive reading and practical experience, together with ability for editorial work, are essential qualifications. Reply in detail, giving training, experience and age, with salary desired. Apply by letter. A-0884.

TECHNICAL MANAGER, as assistant to branch sales manager. Should be mechanical engineer with about five years' experience in design, construction and operation of various classes of prime movers. Executive and sales ability in handling work of a number of engineers in the field essential. Sound theoretical training and broad knowledge of mechanical equipment required, in order that man selected may conduct technical educational campaign throughout sales and engineering organization. State age and give training and experience. Salary $2,000 to $3,000. Apply by letter. A-0885.

MECHANICAL ENGINEER, young. College education and some ability and training in research work. Salary would be from $150 to $200 per month. Location New Jersey. A-0886.

CHIEF ENGINEER, with unusual ability to organize an engineering force for development of design, planning and efficiency experimental work, etc., for large manufacturing company is marketing an article enjoying an international market. Only high-grade successful men will be considered. Splendid opportunity for right man. Apply by letter. A-0887.

PLANT MANAGER, with broad experience in operating lines. Must have unusual ability to handle men. Will be expected to take over an organization of not less than 4000 men in manufacturing a high-grade commercial article in New England territory. Experience required will be along mechanical lines. Must be employed at present time and receiving not less than $8000 per year. Splendid opportunity for right man from standpoint of advancement and emolument. Only very successful operators will be considered. Apply by letter. A-0888.

MEN AVAILABLE

Only members of the Society are listed in the published notices of this section. Copy for notices should be on hand by the 12th of the month, and the form of notice should be such that the initial words indicate the classification. Notices are not repeated in consecutive issues.

MECHANICAL ENGINEER, experienced in power-plant work, heating, sanitary drainage, and fire protection systems in design, layout, purchase of material, and supervision of installation; desires position abroad, preferably in reconstruction work in France or Belgium. American born, age 25. Minimum salary $3,600. A-1.

PRODUCTION ENGINEER, M.E. Columbia 1915; 3½ years' practical experience in shop as inspector, drafting room and office work; production man, conversant with bookkeeping and accounting, desires position, offering good prospects, preferably in or around New York City. Minimum salary $2,500. A-2.

MECHANICAL ENGINEER, age 25, technical graduate; 3 years' experience in design and manufacture of riveted plate metal. Also plant layout and machinery installations. Now Lieutenant in Research Division, Chemical Warfare Service. A-3.

FUEL ENGINEER, graduate M.E., 10 years' experience in combustion work and economical utilization of coal for industrial purposes. Withes to be connected with consulting engineering firm in fuel work. At present time in Government service. A-4.

TECHNICAL GRADUATE, 7 years' experience, power plant and general plant engineering, layout, installation and maintenance, turbines, condensors, boilers, stokers, conveyors, switchboard, gas producers, heating and ventilating systems. Married. Salary $200 per month. Philadelphia preferred. At present employed. A-5.

CHIEF ENGINEER OR CHIEF DRAFTSMAN, member, graduate M.E., resourceful, inventive designer. Shop experience. Age 44 years. New York or Newark preferred. Willing to invest in small or medium concern. A-6.

SUPERINTENDENT OR ASSISTANT, 18 years' experience in mechanical and executive positions, from tool-maker to superintendent inclusive, in high speed production of interchangeable parts. American, 26 years old, married. Will consider any location. A-7.

MECHANICAL ENGINEER, French, 48; extensive engineering, designing and operative experience in United States, Central and South America; steam and gas engine, marine and stationary, mining machinery, machine tools; 10 years' locomotive construction and supervision. Would like connection with firm having interests in Europe or South America. Now employed by U. S. Ordnance. End of war necessitates change. Highest references. A-8.

SPECIALIST IN MARINE, OIL AND GAS engine design with 17 years' practical experience in development and research work. Extensive training in the fine points of both the technical and business side of combustion engineering, competent to handle men and to perfect engine designs along proven lines that will eliminate waste of time and money. Excellent man for assisting war-plants that contemplate shifting over output into new lines. Salary $4,800 per year. A-9.

ENGINEERING EXECUTIVE, now in military service in charge large group on important war research, will be available for industrial service February 1. University training, supplemented by 10 years' successful engineering experience, the last seven as industrial engineer for ten million dollar corporation in charge of staff handling problems of production and business organization. Age 32, married, excellent health. Prefer location in New York or New England in community offering good home and school advantages. Initial salary $5,000, with good opportunity for advancement, and preferably a chance to later acquire an interest in the business if connection is mutually satisfactory. A-10.

TECHNICAL M.E. graduate, 1915, with three years' practical shop experience, desires position, preferably in sales work, or assistant to manager. At present employed by the Navy Department. A-11.

PRODUCTION ENGINEER, graduate M.E. Cornell University, age 28. Now engaged in war work, Captain, Ordnance Department. Available January 1. Desires position as superintendent or assistant superintendent, or similar executive position. Salary $3,000 to $3,600. A-12.

MEMBER, 15 years' experience with consulting engineer in designing and erecting special machinery, laying out industrial plants, blast furnaces, steel mills, buildings, etc. Also experienced in purchasing and exporting mechanical equipment. Now employed. Location, Philadelphia, or the vicinity. A-13.

CONVEYING ENGINEER, two years field engineer and construction foreman for Philadelphia concern; 8 years construction, estimating and sales engineer, now production superintendent for ordnance department U. S. A. and immediately available. A-14.

EXECUTIVE, ELECTRICAL AND MECHANICAL ENGINEER, age 43, married, desires an executive position; capable as an ordnance manager, or efficiency engineer; 15 years' experience in research and efficiency work in executive position; available at once. Least salary, $6,500. A-15.

WORKS MANAGER OR SUPERINTENDENT, age 41, married, graduate engineer, experience from apprentice to works manager in large organizations and modern methods of manufacture of munitions, heavy machinery, engines, single-purpose machines and tools, accustomed to handling all classes of labor. Desires permanent position with large concern where prospects are good. Personal reason for wishing change. A-16.

MECHANICAL ENGINEER. Age 44. Born in Russia, speaks, reads and writes English, Russian and Polish, also some German; technically trained, 13 years' shop practice experience as mechanic; 28 years' total continuous American experience in general mechanical engineering; railway specialist in design and construction of heavy machinery and in design of passenger equipment and structures. Desires position in connection with reconstruction of Russia. Now employed. A-17.

MECHANICAL ENGINEER, equipment to handle responsible position; 25 years' actual experience covering design and construction of shops, power plants, layouts and transmissions, thoroughly conversant with blower systems for heating, ventilating and designing jigs, fixtures, special tools and gages; some experience with automatics. Age 50 years; married. New York preferred. A-18.

GRADUATE M.E. 1917, mechanical and production engineering experience. Location, New York or Long Island preferred. A-19.

FOREIGN TRADE: Technical man, speaking five languages, varied experience in organizing and operating industries, making investigations of trade requirements and possibilities in Europe and the Latin Americas; establishing agencies and directing their activities, permanent connections with a large organization, contemplating the establishment of foreign relations. A-20.

MECHANICAL ENGINEER, master mechanic thoroughly experienced in tools, process, design, etc., on internal-combustion engines; efficiency work, planning and scheduling; plant layout, design and maintenance; 30 years old, American. New York City or vicinity preferred. A-21.

MECHANICAL ENGINEER; power-plant work a specialty. Age 24. Desires location with consulting engineers in Chicago or middle west or with manufacturing concern. Also in the members' exchange; desires to invest money and enter business with a consulting engineer or small concern in the middle west. prefer power-plant work. A-22.

EXECUTIVE ENGINEER, university graduate capable of taking charge of engineering, designing or experimental department; 7 years' experience in design and construction of internal-combustion engines. Practical shop experience and thoroughly acquainted with modern manufacturing methods and systems. A-23.

GENERAL OR WORKS MANAGER. Graduate Worcester Poly. Institute. Age 45, married. Broad selling and manufacturing experience as sales executive and works manager. Special ability in reorganization and the handling of men. Competent to fill very responsible executive position. Temporarily employed in War Dept. Service now available. Location, New York City or vicinity preferred. A-24.

MANAGER of ship yard or large machine works. Many years' experience as general sales manager, managing executive, consulting mechanical and electrical engineer. Employed at present as industrial manager of large and important plant U. S. Navy. Skilled in marine electric propulsion. Only high-grade connection will be considered. Salary $6,000 to $7,500. A-25.

MECHANICAL ENGINEER, 8 years' technical graduate, employed as master mechanic of large industrial plant in charge of power generation and distribution, maintenance and repair of all mechanical and electrical equipment, and repair shops; 2 years drafting and designing. Broad experience with internal-combustion machinery, modern steam turbo-generating plant and mining and milling machinery. Can handle men successfully and produce results to bring costs down to a

possible minimum. Available January 1, 1919. 34 years old, married. A-26.

ENGINEER-EXECUTIVE. Twelve years' experience in the design, construction and operation of industrial plants and public utilities; specialized in the problems of management. Desires position as manager or assistant. Location, New York City or vicinity. At present employed as assistant manager and chief engineer of large corporation. A-27.

AMERICAN, with wide experience in the manufacture of heavy machinery, such as steam shovels, dredgers, pile drivers, cranes and mining machinery, desires position with old established concern. 39 years of age. Salary not less than $3,000. A-28.

MECHANICAL ENGINEER in Government service desires position as assistant to superintendent of progressive manufacturing establishment. Graduate of high-grade technical institution with 3½ years' practical experience. Location in vicinity of Philadelphia preferred. A-29.

MEMBER, 20 years' experience marine engines, turbines, boilers, power plants and auxiliaries, ice machines, etc. Naval architecture, structural and electrical engineering. Now employed by large shipbuilding corporation in machinery fabrication department but desires permanent connection with concern who can offer advancement in keeping with ability. A-30.

HEATING, VENTILATING AND POWER PLANT ENGINEER. Technical graduate desires position as designing engineer or superintendent. At present employed in cantonment construction as mechanical superintendent for contractor. Previous experience designing engineer and chief draftsman in charge of design of mechanical equipment of buildings. Thoroughly conversant with all modern types of heating, ventilating, plumbing and power plant construction. Salary $2,500 to $3,000. Prefer location in East or Middle West. A-31.

M.E. AND C.E. GRADUATE ENGINEER, experienced in sugar engineering, automobiles, tractors, small arms, research engineering, design and production, formerly professor of machine design, now Captain, Ordnance Dept., U. S. A., supervising inspector. Wishes position as chief, production or operating engineer or as professor of mechanical engineering in well-established technical school, or position in France or England. A-32.

TECHNICAL EXECUTIVE AND OPERATING MANAGER with broad standard gage steam-railway operating experience, desires position abroad. American parentage. Technical graduate of two universities, receiving degrees in mechanical engineering and railway engineering. Age 35, unmarried. Experience as practical railway shop expert, designer of locomotives and cars, operating superintendent in the organization and management of steam railway lines, valuation and appraisal of railway property. Now in U. S. military railway service. Good personality, resourceful and dependable. Excellent references. Salary $8,000. A-33.

INDUSTRIAL ENGINEER, 20 years' experience in designing, purchasing, construction, production, manufacturing and maintenance work. Previously chief engineer of large paper manufacturing corporation, operating twenty-five mills. Recently mechanical engineer for contracting company, buying, laying out and installing mechanical equipment for ammonium-nitrate, shell-loading and acid-manufacturing plant. Married. Located in New England but willing to go anywhere for reasonable salary. A-34.

TECHIICAL GRADUATE. Age 28, Captain in supply branch, U. S. A., during war emergency; desires position as assistant to production or works manager of progressive manufacturing concern. Broad training in production with modern methods of centralized graphic control. Electrical and automobile manufacturing experience. Salary about $3,000. A-35.

MECHANICAL ENGINEER, now employed making technical investigations and analyses of reports for the Ordnance Department, U. S. A., seeks connection with scientific management firm in New York City. A-36.

MANAGER OR ASSISTANT MANAGER, technical graduate, U. S. Army officer. Age 29. General manufacturing experience. Active and aggressive executive. Successful record in handling men. Practical knowledge shop methods, plant maintenance, construction, engineering, employment and safety, incentive wage emethods and general office work. Married. Prefer connection as assistant manager of large concern or factory manager small concern. Salary $5,000. A-37.

COMBUSTION ENGINEER. Expert in analysis, management, operation and maintenance of large boiler operations. Experienced in modern equipment and operations up to 60,000 hp.; age 35, technically trained, progressive, excellent references. Would like to locate with firm or corporation having large power house or chain of power houses. Salary $5,000 per year. A-38.

MECHANICAL ENGINEER, experienced executive, technical graduate, 20 years' experience, including special research work, design, construction, maintenance, general supervision and operation of industrial plants. A-39.

ELECTRICAL AND MECHANICAL ENGINEER, age 32 years, married; graduatae of Cornell University and University of Utah; 10 years' experience in generation, transmission, application and sale of energy, management of power concerns; desires position requiring executive capability. Foreign service entirely acceptable. A-40.

CORNELL GRADUATE with 15 years' experience desires connection with tractor or threshing machinery concern as works manager. Experienced in efficiency methods and up-to-date organization; salary dependent on condition and location. A-41.

GRADUATE M.E., 2 years' experience drafting and surveying, 2 years in army as officer. Speaks French, German slightly. Desires position preferably with concern expecting to do engineering work in France. A-42.

EXECUTIVE, mechanical or power superintendent or mechanical engineer. Age 35, married, with wide general mechanical and electrical experience in large industrial plants, chemical plants, paper mills and power plants, with record showing marked improvement in operation and operating costs. Present salary $4,000 per year. Will consider salary of $5,000 with chance of advancement. A-43.

SUPERINTENDENT. Excellent mechanical and manufacturing experience. Age 45. A-44.

ORDNANCE OFFICER, First Lieutenant in Engineering Division. Technical graduate of prominent engineering college. Age 25, married, experienced in mechanical and production engineering in varied line of manufacturing. Qualified to sell mechanical equipment. Willing to go anywhere and especially in reconstruction and development work abroad.

SALES OR PRODUCTION ENGINEER. Army officer expecting discharge at an early date desires connection with progressive concern. Age 28, married, technical graduate. Civilian experience covers 6½ years' designing, manufacturing and selling pumping and filter-plant machinery. Can furnish references from prominent engineers and manufacturers. Minimum salary $3,600. A-46.

FACTORY SUPERINTENDENT, M.E. graduate with several years' experience in manufacturing, filling and casing for export, plain and lithographed cans; thoroughly familiar with dies, special can machinery, soldering machines and conveying systems. Salary to start $3,500. A-47.

M.E. GRADUATE, 33 years old, extensive experience in manufacturing plants, desires position with good live company where advancemens is assured provided work is satisfactory. Holds Captain's commission in Ordnance Department. Reliable and with understanding of proper coördination of departments. A-48.

MECHANICAL ENGINEER, M.I.T. 1917, shop and general engineering experience, desires opening as assistant to mechanical or efficiency engineer. A-49.

DESIGNING ENGINEER, experienced on tools and special machinery for ordnance and aeroplane-engine work, also valves, fittings, boiler accessories and pipage systems. Production experience with 3 years thorough shop training. Technically trained. Age 27. Will go anywhere. Salary considered $2,400. A-50.

MECHANICAL ENGINEER. Technical graduate 1915. Experienced as designer of automobiles starting, lighting and ignition equipment, Army Ordnance. At present with the Government as designer and experimental engineer having had charge of design, manufacture and testing of experimental war material. Desires position preferably production in an executive capacity. Salary $225 per month. A-51.

EXECUTIVE ENGINEER, 18 years' experience in design, construction and operation of textile plants, technical graduate, married, open to engagement with permanent construction company or high-class manufacturing concern. Salary $7,000 or will consider a proposition taking interest in small business. Middle west or New England preferred. A-52.

MECHANICAL ENGINEER, at present constructing large sugar mill in tropics; at liberty December; desires connection with firm doing work in tropics and needing man capable of bringing to a finish big construction. Sugar mill or power plants. Can design and estimate as well as superintend this class of construction. Salary $6,000. Married, age 32. A-53.

SALES EXECUTIVE, with executive, engineering, sales and business ability, can handle general sales department, including advertising, of medium-size manufacturing concern or district office for large concern. 32 years old, married and U. S. native born. Considerable experience in Canadian market. A-54.

ENGINEER EXPERT, both in training and experience; specialized in machinery construction as applied to building operations and ship construction, and production experience. Can furnish the best of credentials. At present employed with Navy Dept. Bureau of Construction and Repair, available any time during 1919; prepared to accept foreign service. A-55.

FACTORY MANAGER OR SUPERINTENDENT, mechanical engineer with 18 years' practical experience in manufacture of light and heavy machinery; twelve years an executive organizer, expert in manufacture of interchangeable machinery, able to originate, design and build automatic or semi-automatic machinery for automobile or printing press. Past experience covers layout of entire plant, purchase and installation of equipment. Would consider representation abroad; thoroughly familiar with European countries and conversant with French language. 38 years old, married. Salary $6,000. A-56.

CONSTRUCTION ENGINEER, 12 years' experience design and construction of factories, large buildings and shipyards, including the mechanical, electrical and civil engineering features. Responsible charge of construction of over $12,000,000 worth of work for private interests including preparation, letting and adjustment of contracts; experience in maintenance and operation of completed structures and power plants. Cornell graduate, M.E., age 34, leaving Government position held during war and desires to make permanent connection with factory or construction company. Earned $7,000 to $8,000 per year before war. Will consider less on agreeable work with prospects of advancement. Particularly interested in labor problems. Location near New York City preferred. A-57.

POWER SPECIALIST, 10 years' unusual experience in design, construction and operation of steam, hydroelectric and internal-combustion engine power houses; high-tension distribution, electric substation work and the application of industrial power to machine-tool equipment. Recently in charge of 50 men on the design and construction, and 1000 men

on all mechanical and electrical work at a 12-way, 8800-ton tractor employed by the Emergency Fleet Corporation. Executive engineer of good personality, age 30, married, M.E. degree; open for employment January 1, 1919, with contractor, consulting engineer or manufacturer. A-58.

EXECUTIVE, DESIGNER, Harvard A.B., 1909, Cornell, M.E., 1911. Age 32, married; 7 years' practical experience in shop, drafting room, industrial plant and isolated field work in connection with internal-combustion and steam engines; gas producers and boiler plants. Experienced in organization work and recently state boiler-plant conservation work for U. S. Fuel Administration. Desires management of small business with partnership or stock interest. Minimum salary $3000. A-59.

MECHANICAL ENGINEER, graduate, 5 years' experience in development and manufacture of machine tools, instruments and steel-plate work, as designer, estimator, plant engineer. Desires executive position. At present with the Government in executive engineering capacity. New York or Boston district preferred. A-60.

MECHANICAL ENGINEER. Technical graduate. 17 years' experience in the design, construction, testing and operation of steam power plants, 11½ years' as designer, builder and superintendent of power plants and stationary steam equipment with two of the largest eastern railroad systems. At present employed as engineer with public utility operating and engineering corporation. Desires to return to steam railroad work or enter permanent employ of strong manufacturing company. A-61.

SUPERINTENDENT OR PRODUCTION ENGINEER, age 44. Mechanical engineering graduate, 16 years' experience in industrial engineering lines, 8 years with present employer in supervision of rate setting, production planning. Costs, pay roll, shop accounting, etc. for shop employing 600 to 900 people. Position in which an interest in business could be obtained preferred. Location Chicago. A-62.

AUTOMOBILE AND AIRPLANT ENGINE EXPERT just released from Army, wants position with school or manufacturing concern. Graduate M.E. Cornell University, 1909. Thorough knowledge of carburetion, ignition, starting and lighting systems, storage batteries, etc. Also experience in experimental work of various kinds. Salary not less than $3000. A-63.

SUPERINTENDENT OR CHIEF ENGINEER of power plant, or power engineer for manufacturing plant; 14 years' experience since graduation. American, 36 years. Design, construction operation and maintenance of steam plants and substations a specialty. Salary $3000. Eastern States. A-64.

POWER ENGINEER, 7 years' experience in construction, operation, reconstruction and design of power plants, buildings, and equipment. Covering boilers, stokers, turbines, oil engines and refrigeration equipment. Supervising engineer for consulting engineering firm of New York before entering U. S. Navy as Ensign. Desires to cover the purchase of equipment, direction of field work, and organization of plants on an efficient and economical basis. Salary on entering service $3000. Willing to go anywhere. Available about February 1. A-65.

SALES ENGINEER. Member, with New York office will accept manufacturers' account or representative for special or plant equipment. Broad selling experience combined with practical manufacturing shop knowledge. Resourceful. Bank reference. A-66.

ASSISTANT ENGINEER OR SUPERINTENDENT; technical graduate, age 28, married. 5 years' general shop, maintenance and construction work; one year experimenting with powdered coal. Desires permanent position with large manufacturing corporation. Active and energetic. Now employed. Location preferably East or Middle West. A-67.

DRAFTSMAN AND SALESMAN specializing in iron and bronze; 1½ years chief estimator leading car works; 3½ years chief estimator engineer, design, manufacture, sale and installation conveying apparatus of all types. At present commissioned officer U. S. Army, Ordnance Dept. design and production work. Available about January 15. A-68.

INDUSTRIAL PLANT ENGINEER. Age 40, married. Technical education; 16 years' wide experience in industrial plant engineering and management consulting, designing, construction, organizing, maintenance, shipyards, paper and pulp mills, power plants. Desires position as engineering manager or works engineer. Executive ability with broad knowledge of plant management and organization. A-69.

MANAGER with broad manufacturing experience and successful record desires big, difficult executive position. A-70.

MECHANICAL ENGINEER desires staff connection with firm of industrial engineers, to undertake for clients power-plant investigations, schedule process steam demands, and effect fuel economies. A-71.

PRODUCTION ENGINEER, graduate mechanican engineer, age 27. Experience in supervising including routing, scheduling and developing progress charts and reports; following up machine-shop production and operations from time of casting ingot to shipment. One year's experience as chief inspector of small arms. Philadelphia or vicinity preferred. A-72.

SUPERINTENDENT, mechanical or production engineer; energetic, progressive American, married; technical education with broad experience in shop, drawing room and production on small interchangeable parts. Ability to produce results. At present employed. Available at early date. A-73.

GRADUATE UNITED STATES NAVAL ACADEMY, honorable resignation from the U. S. Navy; age 36, married; 6 years' civilian executive engineering experience, followed by enrollment in U. S. Naval Reserve Force. At present stationel in China. Would like to get in touch with firms who are either now operating or who contemplate starting in any part of the Far East. A-75.

MECHANICAL ENGINEER, officer in the Engineere Corps, U. S. Army, age 33, desires position affording opportunity for exercise of executive ability. Technical training and experience in construction and operation industrial plants. Thoroughly familiar with power plants and power-plant equipment; experienced in machine design; broad general business training. Minimum salary $300 month. Available about January 1. A-75.

COMBINATION ENGINEER desires position with company whose fuel consumption is sufficient to require services of first-class man. Technical training, wide experience in practical problems of design and operation of furnaces for special work, machine designer. Available on release from military service on or about January 1. A-76.

MECHANICAL ENGINEER, age 25, married; M. I. T. graduate with 2½ years' practical experience in industrial and power-plant engineering. Desires to become connected with concern that can offer future in return for hard work, energy, and initiative. Willing to make moderate start if future is assured. Now employed. Location preferably in the East. A-77.

MECHANICAL ENGINEER, technical graduate, age 24. Release from active duty in Naval Reserve in December. Experienced foundry engineer, metallurgist, and metallographist. Will consider position as estimator for foundry or steel-works equipment, or sales engineer and special representative for manufacturer. Varied experience in the engineering field and natural curiosity and ingenuity gives qualifications for position as assistant to work manager or superintendent. A-78.

PRODUCTION ENGINEER, desires position where opportunity is given to show initiative and accomplish constructive work. Experience in plant management and reorganization; association with leading industrial engineers and executive experience in several large plants as superintendent and production engineer. Technical graduate, age 28 years. A-79.

ADVISORY ENGINEER, 25 years experience in design of blast furnaces, steel plants, hydraulic machinery, sugar mills, machine shops, foundries, boiler shops, power plants, and heavy machinery as well as supervising the erection and construction, including laying out foundations and placing and erecting buildings and machinery. A-80.

NAVAL AVIATION ENGINEER OFFICER; M.E., Stevens, 1909; age 31; served apprenticeship in machine shop of gasoline-engine manufacturer. Has held position of draftsman, efficiency and plant engineer; employment supervisor, factory superintendent and mechanical engineer with well-known manufacturing concerns. A-81.

COMBUSTION ENGINEER, 10 years' experience with coal, gas and oil firing, wishes to make change. A-82.

MECHANICAL ENGINEER with 7 years' broad mechanical manufacturing experience, desires position with possibilities as superintendent or manager, upon release from active duty as commissioned officer in Ordnance Department. Can furnish best references. A-83.

MECHANICAL ENGINEER with 15 years' experience in design of heavy machinery, plant and building construction, thoroughly familiar with shop and field methods; desires permanent connection with definite opportunities for advancement. Technically trained, with experience as machinist. Age 36, married. A-84.

ELECTRICAL, MECHANICAL DRAFTSMAN, graduate Rose Polytechnic Institute, 1915. In charge drafting, last three years on work including shell machinery, oil-well equipment, hydraulic pumps, safety work. Would like opportunity leading to works management, efficiency or sales engineer. A-85.

DIESEL ENGINEER SPECIALIST, with 3 years' experience erecting, testing, design, and computation of Diesel engines. M.E. Mass. Inst. Tech. Now holds responsible technical position. Desires change from advanced experimental work on Diesels to position involving standard practice. A-86.

ENGINEER, just discharged with rank of lieutenant, Engineer Corps; 3½ years' prior experience in power-plant and distribution systems, design and construction in all their electrical, mechanical, and structural details. Age 26, married; available at once. Salary $2400. A-87.

PRODUCTION OR MECHANICAL ENGINEER would like to become permanently established with live or growing concern; inventive and executive ability, age 31, married. Excellent references. At liberty the first of the year. A-88.

MECHANICAL AND CIVIL ENGINEER, several years in charge of engineering department with large manufacturing company, desires to make change. Experience has been in estimating and designing with close connection with production. Also in charge of building design construction and plant extension. Preference, assistant to manager of large and growing plant. Would consider car specialty concern of recognized standing. A-89.

GRADUATE MECHANICAL ENGINEER, just released from 15 months' military service, captain artillery, now interested in steam power-plant proposition, or manufacturing, operating or consulting opportunities. A-90.

MECHANICAL OR PLANT ENGINEER, 3 years at engineering college, 5 years apprentice engineering works, 12 years' practical experience. Last 5 years in charge of engineering department of large manufacturing establishment. Married; 35 years of age. A-91.

MECHANICAL ENGINEER, technical graduate, desires position as manager where executive ability is necessary, with an extensive knowl-

edge of modern scientific and production management methods. Held positions of superintendent and factory manager and with consulting industrial engineers. Only a high-grade proposition will be considered. A-92.

PRODUCTION MANAGER. Mechanical engineering graduate, familiar with practical machine-shop and foundry work and relating office methods. Desires position with progressive manufacturing firm requiring an energetic and tactful executive. At present in Government service, available the first of the year. Excellent references. 30 years old, married. Salary $3000. A-93.

MECHANICAL AND SALES ENGINEER, age 36, married, 19 years' experience. Available on January 1, 1919, familiar with European business practice. Desires agency for South America or Europe, flour-mill and grain-elevator machinery; Diesel-oil engine, marine or stationary, gas producer for bituminous coal gas or steam engine. Salary and commission preferred. Can lay out plants and superintend erection or installation of same. A-94.

YOUNG MECHANICAL AND CHEMICAL ENGINEER, desires to change position. Experienced in construction, operation, and maintenance of industrial works. References. Location wherever desirable. A-95.

MECHANICAL ENGINEER, desires connection in sales engineering or executive capacity. American, in excellent health. Graduate University of Michigan in engineering and naval architecture. Unusual combination of successful selling, technical and business experience in both mechanical and marine fields. Former member Chicago firm mechanical and electrical engineers; also business manager large real estate and contracting firm. At present employed on Government shipbuilding work, but seeks permanent connection. Will go anywhere, and available on reasonably short notice. A-96.

MECHANICAL ENGINEER, University technical education, desires connection of executive nature with manufacturing concern, preferably in early stages of development. Several years' experience directing work in office, plant and field along lines of plant construction, design and installation of mechanical equipment, plant operation and sales. At present holding commission in Government service. Will consider position in foreign field. A-97.

MECHANICAL ENGINEER, technical graduate, desires position in executive department of engineering or manufacturing concern; 12 years' experience covering design, construction and manufacturing. American, age 35; married; energetic and trustworthy. Employed at present but available on short notice. A-98.

MECHANICAL ENGINEER, desires position as technical executive. American and British training and experience, in hoisting machinery and structural engineering. Student of modern organization and production methods. At present chief draftsman of large concern. Desires position in South America or Europe with up-to-date plant or in developing freight-handling facilities at ocean terminals. A-99.

MECHANICAL ENGINEER, technical graduate, 14 years' general engineering experience, including machine design, executive staff work, supervision of heavy construction, machinery installation and manufacturing, desires position requiring executive ability as resident engineer or manager. Only a high-grade proposition will be considered. A-100.

STEAM TURBINE DESIGNER, age 43, expert designer of steam engines and turbines and highly trained mechanical and electrical engineer; now employed by the Navy Department wishes to return to commercial work in an executive position. A-101.

MAJOR ENGINEER, R.C., about to return from active service as major of engineers abroad, desires connection with firm of consulting engineers or employment as manager or superintendent. Familiar with power and refrigerative plants, factory, layout and management, machine-tool design, and manufacture of duplicate machinery. A-102.

MECHANICAL ENGINEER, GENERAL SUPERINTENDENT, 30 years old, technical and practical experience. Machine-shop practice as tool-room superintendent; designer of special machinery, chief draftsman, special fixtures, tools, etc.; experienced in systematizing cost accounting, equipment developing experimenting. At present production superintendent. Originator of devices for manufacturing; has initiative, resourcefulness; seeks position of responsibility and permanency after January 15, 1919. T-103.

GENERAL OR WORKS MANAGER. Authority on modern employment and personnel problems. Graduate mechanical engineer and B.A. in economics; 20 years' experience including cost accounting, production management, purchasing and superintendence. Now holding professorship as head of department in large engineering college and consulting practice. Author of well-known books on industrial organization and management. Major of Ordnance since July 1917, having had charge of important equipment, production, and inspection work in ammunition and artillery. A-104.

MECHANICAL ENGINEER, technical degree, age 31, not married; 8 years' experience on general structural design, inspection work, construction of large mining plants, also buying and selling of machinery. Four years spent in South America, good knowledge of business conditions in that country. Desires to join firm where technical knowledge of foreign business would be of service. A-105.

MAINTENANCE AND CONSTRUCTION ENGINEER familiar with superintendence of building construction, installing automatic machinery, heat-treating furnace, fuse-oil storage equipment. Available on short notice. A-106.

ENGINEER, experienced in design, construction and operation of power plants, accustomed to take full charge of both office and field work; experience also covers design of special machinery and industrial layouts, special investigation in power problems, etc., desires location in vicinity of New York City. A-107.

GRADUATE MECHANICAL ENGINEER, with 2 years' experience on electrical and mechanical equipment. Discharged Army officer. Position desired with an industrial establishment as assistant to works manager or with industrial engineer. A-108.

EXECUTIVE ENGINEER, office and field executive in general engineering and contracting company. 20 years' broad experience covering the purchase, installation and maintenance of mechanical and electrical equipment for power, contracting and industrial concerns. Sales manager of electrical apparatus. Now in Government position. Available at once. Seeks responsible permanent connection. Technical graduate. Married. Salary $5,000. A-109.

MECHANICAL, CONSTRUCTION, PRODUCTION WORKS and plant-maintenance engineer, 32 years old, single, technical college education; several years varied engineering experience, in this country and abroad such as steel construction, power plants, foundry, machine and forge shops, preparing plans and specifications, estimates, etc., speak several foreign languages, considered good shop and office organizer and executive. Formerly captain U. S. A., recently discharged. Can present best reference. A-110.

PLANT ENGINEER, technical executive or assistant executive of any kind, requiring position of promise and responsibility as technical graduate; eight years' experience in executive capacity, covering manufacturing, plant testing, consulting engineer and teaching in machine design and power plants; at present 1st Lt. in U. S. Army, Ord. Dept., on design and manufacture of field carriages. 29 years of age, married. Location preferably New York or vicinity; salary $2,600-$3,600. A-111.

TECHNICAL GRADUATE age 26, 2 years' practical shop and 2 years' drafting experience. At present as leading draftsman in charge of work. References furnished as to ability, character, etc. Location, preferably Eastern States. A-112.

MECHANICAL ENGINEER. Graduate of Cooperative engineering course, University of Cincinnati, 1913, Junior Member, age 28, married. Now lieutenant in United States Army and will be available for civilian position about January 10, 1919. Four years' experience in consulting office, including two years as executive. Experience covers all details of mechanical, electrical and sanitary equipment for industrial buildings and design, construction and operation of steam power plants. Consulting practice chiefly in connection with paper mill work. Desires position in similar capacity with industrial engineer or architect, or other executive capacity in line with qualifications. Preferably in Middle West. A-113.

FACTORY EXECUTIVE who for some time has devoted his services to the U. S. Government on special work, would like to correspond with well-established concern. Experience consists of 21 years' in principal capacity with several well-known concerns in this country and Europe, in the manufacture and development of high-grade intricate mechanical devices, requiring extreme accuracy, interchangeability of parts, together with a very efficient organization, highest type of men, tools and equipment. A-114.

CANDIDATES FOR MEMBERSHIP

TO BE VOTED ON AFTER JANUARY 21

BELOW is a list of candidates who have filed applications since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted. The total number of applications received and listed below is 163.

The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted. All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by January 21, and provided satisfactory replies have been received from the required number of references, they will be balloted upon by the Council.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

California

DARRAH, WILLIAM A., Plant Manager, Noble Electric Steel Co., Heroult

HEYLMAN, FREDERIC C., Chief of the Mechanical Department, Shell Company of California, Martinez

JESSURUN, DAVID, Superintendent, The Anaheim Sugar Co., Anaheim

JONES, EDWARD S., Assistant Engineer, Gas Department, Pacific Gas & Electric Company, Sacramento

KOEBIG, A. H., Consulting Engineer, Los Angeles

MARTIN, JESSE C, JR., Mechanical Engineer, J. C. Martin Company, San Francisco

Connecticut

ADT, HOWARD E., Treasurer & General Manager, The Geometric Tool Company, New Haven
BRANCHERRY, JOSEPH M., Production Engineer, Colts Patent Arms Company, Hartford
GAINES, WILBUR H., Superintendent, Factory "H," International Silver Co., Meriden
HAMMOND, GUY L., President & Treasurer, Block Rock Mfg. Company, Bridgeport
LAWRENCE, WILLIAM E., Head of Model Department & Designing Engineer, Marlin Rockwell Corporation, New Haven
RUST, CHARLES E., Supervisor of Apprentice Training School at the Bullard Engineering Works, Inc., Bridgeport

Delaware

BRUCE, ROBERT G., Mechanical Engineer, E. I. du Pont de Nemours & Co., Wilmington

District of Columbia

BALL, C. WINTHROP, Chief Draftsman, Engineering Division, Ordnance Department Aircraft Armament Section, Washington
STOVER, HARVEY D., Lieutenant Ordnance Engineer, Engineering Division, Aircraft Armament Section, Washington
STUART, KENNETH E., Member, Engineering Committee National Research Council, Washington

Illinois

EKLIND, CARL E., Chief Draftsman, Car Construction Department, Atchison, Topeka & Santa Fe Railway Company, Chicago
HELT, HARRY C., Assistant to Superintendent Engineering and Planning, Small Arms Division, Rock Island Arsenal, Rock Lsland
JAMES, SYDNEY V., Mechanical Engineer, Underwriters' Laboratories, Chicago
MORRISON, MONTFORD, Consulting Engineer, Victor Electric Corporation, Chicago
ROGERS, FRANKLIN G., Sales Engineer, Under-Feed Stoker Co. of America, Chicago

Indiana

CREAGER, EDWIN F., Works Manager, Remy Electric Division, Anderson
TEST, ELLIS W., Chief Mechanical Engineer, Haskell & Barker Car Company, Inc., Michigan City

Kentucky

WARE, ARTHUR L., Mechanical and Mining Engineer, Hazard

Maryland

EISERT, HERMANN, Mechanical Engineer, C. L. Reeder, Baltimore
HIGGINS, MAX S., General Manager, New York Central Iron Works Co., Inc., Hagerstown

Massachusetts

COYNE, JAMES F., Garage Manager, Seekonk
HAWLEY, THOMAS, President, Hawley School of Engineering, Boston
VAN LAW, CARLOS W., Consulting Engineer, Boston

Michigan

FENKELL, GEORGE H., Superintendent & General Manager, Board of Water Commissions, Detroit
HUNT, HORACE S., Administrative Engineer for Michigan, United States Fuel Administration, Detroit

Missouri

MARTINDALE, GERALD S., Construction Engineer, Curtis & Co. Mfg. Co., St. Louis

New Jersey

ANDERSON, RICHARD T., Branch Manager, Crocker-Wheeler Company, Newark
BRADY, THOMAS, Superintendent, Elevator Supplies Company, Inc., Hoboken
FORIS, JULIUS, Tool & Machine Designer, The Singer Sewing Machine Manufacturing Company, Elizabeth
KORTGARD, FREDERICK H., Foreman Engineer, Jersey City Power Station, U. S. Railroad Administration, Hudson & Manhattan R. R., Jersey City
McCLYMONT, JAMES, 2nd Vice-President, Hall Printing Press Company, Dunellen

New York

BARNSLEY, HERBERT J., Chief Draftsman, Jenkins Brothers, New York.
BORGSTEDT, HENNING N., Sales Engineer, De La Vergne Machine Company, New York
BYER, HENRY E., Chief Engineer, Condenser Department, Ingersoll Rand Company, New York
CHAMBLISS, HARDEE, Major, Ordnance Department, U. S. A., Laurel Hill Detachment, Laurel Hill, Long Island
CHURCHILL, WILLIAM L., Consulting Engineer (Industrial Efficiency), New York
COURTLAND, WILLIAM A., Vice-President & Engineer, H. W. Cotton, Inc., New York
ERDMAN, ALBERT W., Lieutenant-Colonel, Ordnance Department, U. S. A., Schenectady
ESTEP, FRANK L., Chief Engineer, Perin-Marshall Company, New York
HICKS, OSCAR P., Sales Engineer, Mathews Gravity Carrier Company, New York
LIPKE, LEOPOLD H., General Manager, Gotham Machine & Tool Company, Inc., Brooklyn
LISETZKY, PETER A., Chief Engineer, Gun Carriage Plant, New York Air Brake Company, Watertown
MARTIN, KINGSLEY L., President, The Engineer Company, New York
PASCALE, PASQUALE, Designing Engineer, Galvanizing Corporation of America, Brooklyn
RANKIN, WILLIAM J. A., Cableway & Logging Engineer, Lidgerwood Manufacturing Company, New York
RAYMOND, FRANK S., Draftsman, Watervliet Arsenal, Watervliet
RICHARDS, HORATIO R. H., First Assistant Production Engineer, Standard Shipbuilding Corporation, Shooters Island
ROBB, EDWARD H., Chief Draftsman & Assistant to Engineer, Long Island Railroad, Richmond Hill, Long Island
ROSSIRE, HENRY L., Production Manager, U. S. Ordnance Department, New York District, New York
STEVENS, JOHN E., Mechanical Engineer, General Briquetting Company, New York
STRUNK, WALTER C., Assistant Engineer, Interborough Rapid Transit Company, New York
SUTHERLAND, KENNETH W., Chief Assistant Inspection Officer, Department of Gages & Standards, British War Mission, New York

Ohio

BAKER, WALTER C., Consulting Engineer, The Standard Parts Company, Cleveland
CUNNINGHAM, GEORGE F., Designing Draftsman, Ohio Blower Company, Cleveland
DIBBLEE, WALTER A., District Manager, Inspection Division, Ordnance Department, U. S. A., Cincinnati
FIELD, J. A., Planning Engineer, The B. F. Goodrich Company, Akron
MARSHALL, EDWARD M., Combustion Engineer, Union Gas & Electric Company, Cincinnati

Pennsylvania

BATTEY, WILLIAM A., Vice-President, Pennsylvania Crusher Company, Philadelphia
FORKER, JOHN N., Chief Draftsman, The Koppers Company, Pittsburgh
GRAHAM, ALVIN K., General Manager, Erie Bolt & Nut Company, Erie
HARTMAN, WILLIAM H., Chief Engineer, Pennsylvania Crusher Company, Philadelphia
KENNEDY, MATTHEW G., Assistant to Electrical Engineer, The United Gas Improvement Company, Philadelphia
LATIMER, JOHN, Superintendent of Meters, Bureau of Waters, Philadelphia
RITTMAN, WALTER F., Consulting Engineer, Pittsburgh
SUCZEK, ROBERT, Consulting Engineer, C. H. Wheeler Manufacturing Company, Philadelphia

Tennessee

HENSON, WALTER A., Vice-President, Osage Cotton Oil Company, Chattanooga

Texas

GILLESPIE, SOLOMON E., Assistant Engineer, The Murray Company, Dallas

Vermont

WINESTOCK, OTTO C., Inventive Industrial Research, Perkinsville

Washington

GODFREY, FOSKETT H., Superintending Engineers Constructing Quartermaster, Camp Lewis
THOMPSON, WALDO E. Mill Builder, Tacoma
WENK, MORRIS, Engineering Draftsman, G. M. Standifer Construction Corporation, Vancouver

Canada

CARTER, WILLIAM, Manager, Ingersoll Rand Company, Montreal
JONES, THOMAS M. Chief Engineer & Manager, The Bawden Pump Company, Ltd., Toronto
McKEE, GEORGE M., General Manager, The Donnacona Paper Company, Ltd., Donnacona, Quebec

Hayti

HOLLY, ROBERT A., Assistant Engineer, Stewart's Engineering Corporation, Port-Au-Prince

FOR CONSIDERATION AS ASSOCIATE OR ASSOCIATE-MEMBER

Connecticut

CAMPBELL, JAMES A., Assistant Scheduling Supervisor, Winchester Repeating Arms Company, New Haven
MORRISEY, RICHARD E., Component Engineer, Colts Patent Fire Arms Company, Meriden

District of Columbia

LEILICH, FRANK T., Captain of Engineers, U. S. A., Washington

Connecticut

SHRINER, EDWARD C., JR., 2nd Lieutenant, Ordnance Department, U. S. A., Assistant Supervisor on Fuses, Adapters and Bosters, Bridgeport

New Jersey

GERBER, LIPMAN S., 1st Lieutenant, Ordnance Department, 511th Casual Company, Camp Merritt
SOBEN, ADOLPH F., Designer, Splitdorf Electric Company, Newark

New York

HALLSTED, SEYMOUR J., Chief Engineer, The Griscom-Russell Company, New York

Pennsylvania

BUCKLEY, JAMES E., Turbine Designer, Bethlehem Shipbuilding Corporation, Bethlehem
DONEGAN, JOHN J., Foreman, Forge Department, Frankford Arsenal, Philadelphia
WILLIAMS, JOHN F., Construction Engineer, Atlantic Refining Company, Philadelphia

Rhode Island

SPRAGUE, FRANK D., Lieutenant, U. S. N. R. F., Exp. Officer, Torpedo Station, Newport

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

Connecticut

BALSOR, FREDERICK N., Assistant Resident Inspector of Engineering Material, U. S. Navy, care Ashcroft Manufacturing Company, Bridgeport
COOK, HARMON T., Works Manager, The Torrington Co., Torrington

District of Columbia

LANG, HERBERT H., Supervising Inspector, Ordnance Department, U. S. Army, Washington
LAMBERT, STANLEY M., Assistant Branch Head, War Department, Estimates & Requirements Division, Washington

Illinois

FISKE, ROGERS A., First Assistant to Officer in Charge of Production, Rock Island Arsenal, Rock Island
RICE, PERRY W., Manager, Chicago Branch, Pratt & Whitney Company, Chicago

Massachusetts

NICKERSON, HAROLD L., Superintendent of Production & Employment Manager, Walden-Worcester, Inc., Worcester

Nebraska

LUEBS, AUGUST A., Instructor Mechanical Engineering, University of Nebraska, Lincoln

New York
KEEFE, DANIEL C., Mechanical Engineer, Ingersoll-Rand Company, New York
SIMPSON, ROBERT E., JR., Check Inspector, Gas Defense Plant, U. S. A., Long Island

Ohio
PATCHELL, FREDERICK J., Assistant Chief, Materials Engineering Department, Bureau Aircraft Production, Dayton

Pennsylvania
HILL, DAVID B., Mechanical Draftsman, Ordnance Department, Frankford Arsenal, Frankford
KARN, FRED S., Sales Engineer, Dravo-Doyle Company, Pittsburgh

Virginia
LEFEBVRE, GORDON, Maintenance Engineer, Du Pont Company, Hopewell

West Virginia
RINKE, GEORGE R., Chief Engineer, West Virginia Traction & Electric Company, Morgantown

Canada
HASTIE, CHRISTOPHER, Surveyor, Lloyd's Register of Shipping, Vancouver, B. C.
PARKIN, JOHN H., Mechanical Engineer, British Acetones Toronto, Ltd., Toronto, Ontario

France
STEINS, CARLETON K., 1st Lieutenant, Engineers, U. S. A., Co. "O," 35th Regiment, American Expeditionary Forces.

FOR CONSIDERATION AS JUNIOR

California
BERCAW, CORLISS A., Chief Quartermaster, Aviation, U. S. N. R. F., Whittier
CHRISTIAN, JOSEPH D., Mechanical Engineer, P. H. Reardon, San Francisco

Connecticut
DURKEE, CHAUNCEY H., 1st Lieutenant, Ordnance Department, U. S. A., Colt's Patent Fire Arms Manufacturing Company, Hartford
WHITAKER, JOHN A., Assistant Chief Draftsman, Colt's Patent Fire Arms Manufacturing Company, Meriden

District of Columbia
MCCUTCHEN, BRUNSON S., Captain, Ordnance, U. S. A., Washington
SORENSON, JAMES C., Designer, Ordnance Office, U. S. Army, Washington

Illinois
HABERSTROH, HERBERT N., Selling Engineer, Celite Products Company, Chicago

Louisiana
FREELAND, EMILE C., Assistant Research Chemist, Louisiana Sugar Experiment Station, New Orleans

Maryland
BROWN, ERNEST G., 2nd Lieutenant, Ordnance Department, U. S. A., Aberdeen Proving Grounds, Aberdeen
WELLS, BURLING D., 1st Lieutenant, Chemical Warfare Service, Edgewood Arsenal, Edgewood

Massachusetts
ALDRIN, EDWIN E., 1st Lieutenant, Instructor in Aeronautics, Massachusetts Institute of Technology, Cambridge

Michigan
HIGGINBOTTOM, HERBERT, JR., Tool and Gauge Designer, Packard Motor Car Company, Detroit

Minnesota
GREENBERG, MORRIS, Instructor Exp. Engineering Department, University of Minnesota, St. Paul

Missouri
SHANKS, EVERETT C., Assistant Superintendent Machine Shops, Curtis & Co. Mfg. Co., St. Louis

New Jersey
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France
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Canada
HEINEMANN, ADELBERT L., Engineer of Tests, Ordnance Department, U. S. A., Canadian Allis-Chalmers, Ltd., Toronto

SUMMARY

New Applications	146
Applications for change of grading:	
Promotion from Associate-Member	5
Promotion from Junior	12
Total	163

SUMMARY SHOWING AVERAGE AGE AND POSITIONS OF APPLICANTS ON BALLOT, DECEMBER 14, 1918

Average age of applicants:	
Members	41
Associates	39
Associate-Members	34
Juniors	26
Chief Engineers	2
Commercial Engineer	1
Consulting Engineers	2
Designers	4
Draftsman	1
Chief Draftsman	1
Assistant Chief Draftsman	1
Efficiency Engineer	1
Electrical Engineer	1
Executives (Pres., Vice-Pres., Secy., Mgrs.)	8
Hydraulic Engineer	1
Instructor	1
Maintenance Engineer	1
Master Mechanic	1
Mechanical Engineers	5
Assistant Mechanical Engineers	4
Plant Engineer	1
Assistant Plant Engineer	1
Production Engineers	2
Sales Engineers	2
Steam Engineer	1
Senior Engineer	1
Superintendents	6
Assistant Superintendent	1
Miscellaneous	5

UNITED STATES GOVERNMENT SERVICE

Majors	2
Lieut. Colonel	1

THE ENGINEERING INDEX

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Mechanical Engineering

AIR MACHINERY

Air Conditioning

Air Conditioning, Charles L. Hubbard. Domestic Eng., vol. 85, nos. 3 and 4, Oct. 19 and 26, 1918, pp. 82-84, 2 figs. and 118-120, 5 figs. Possibilities of this branch of heating and ventilating engineering and how it may save coal and raise efficiency of employees in industrial plant.

Pneumatic Tools in Winter

Effects of the Use of Pneumatic Tools on the Nervous System, Francis M. Barnes. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 239-240. Reccommends warming chisel in cold weather, enlarging or covering shank to prevent cramp in hand muscles, and condemns practice of blocking exhaust outlet, thereby forcing current of cold air over fingers. From Proc. Seventh Annual Safety Congress.

CORROSION

A Case of Corrosion Caused by Electrolytic Action in a Westinghouse-Leblanc Air Pump (Un cas de corrosion à allure électrolytique dans une pompe à air Westinghouse-Leblanc), L. Conge. Revue Générale de l'Electricité, vol. 4, no. 15, Oct. 12, 1918, pp. 539-540, 2 figs. States that no pipe or machine element intended to operate exposed to direct action of any kind of water should be composed of metals capable of forming a voltaic couple.

FOUNDRIES

Brass Foundry

A Brass Foundry With Automatic Ventilation, Charles Vickers. Foundry, vol. 46, no. 316, Dec. 1918, pp. 568-574, 11 figs. Description of foundry with its ventilation arrangements.

Coreroom

Modern Coreroom for Malleable Foundry, Donald S. Barrows. Iron Age, vol. 102, no. 21, Nov. 21, 1918, pp. 1254-1255, 5 figs. Designed and constructed for 50,000-ton foundry, provides for economical handling of raw materials and finished cores. Abstract of paper before Am. Foundrymen's Assn., Oct. 1918. Also in Foundry, vol. 46, no. 316, Dec. 1918, pp. 577-578, 5 figs.

Die Casting

Die-Casting of Aluminum, H. Rix and H. Whitaker. Sci. Am. Supp., vol. 86, no. 2237, Nov. 16, 1918, pp. 314-315. Advantages; heat treatment; material for dies; cost of process. Paper before Inst. of Metals.

Furnaces

Continuous Tunnel Furnace in Malleable Industry, Philip d'H. Dressler. Foundry, vol. 46, no. 316, Dec. 1918, pp. 566-567, 5 figs. Discussion of paper by H. E. Diller on Experiments in Annealing Malleable Iron, at annual meeting of Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

Electric Furnace in the Steel Foundry, W. E. Moore. Iron Age, vol. 102, no. 20, Nov. 14, 1918, pp. 1206-1207. Comparison of electric and converter costs; relation to power station; future of electric steel foundries. From paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

Oil-Burning Cupola Operations Analyzed, John Howe Hall. Foundry, vol. 46, no. 316, Dec. 1918, p. 558. Results attained in melting iron for 3-ton converter plant point to saving in fuel and labor with more steady output. From paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

Ladles

Suggest Standard Sleeves and Nozzles. Brick & Clay Rec., vol. 53, no. 11, Nov. 19, 1918, pp. 882-883, 21 figs. Standard dimensions for round-face and straight-face nozzle brick for foundry ladles proposed by Am. Face Brick Assn., also dimensions of sleeves for foundry ladles proposed by a committee of

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Note.—The abbreviations used in indexing are as follows:

Academy (Acad.)
American (Am.)
Associated (Assoc.)
Association (Assn.)
Bulletin (Bul.)
Bureau (Bur.)
Canadian (Can.)
Chemical or Chemistry (Chem.)
Electrical or Electric (Elec.)
Electrician (Elecn.)
Engineer[s] (Engr.[s])
Engineering (Eng.)
Gazette (Gaz.)
General (Gen.)
Geological (Geol.)
Heating (Heat.)
Industrial (Indus.)
Institute (Inst.)
Institution (Instn.)
International (Int.)
Journal (Jl.)
London (Lond.)
Machinery (Machy.)
Machinist (Mach.)
Magazine (Mag.)
Marine (Mar.)
Materials (Matls.)
Mechanical (Mech.)
Mining (Min.)
Municipal (Mun.)
National (Nat.)
New England (N. E.)
New York (N. Y.)
Proceedings (Proc.)
Record (Rec.)
Refrigerating (Refrig.)
Review (Rev.)
Railway (Ry.)
Scientific or Science (Sci.)
Society (Soc.)
State names (Ill., Minn., etc.)
Supplement (Supp.)
Transactions (Trans.)
United States (U. S.)
Ventilating (Vent.)
Western (West.)

steel men and founders in joint assembly with a committee of manufacturers of sleeve and nozzle brick.

Malleable Iron

Malleable Iron Castings, P. A. Paulson. Iron Age, vol. 102, no. 21, Nov. 21, 1918, p. 1266. Advantages over steel castings for agricultural purposes. From paper presented at Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

The Integrity of the Malleable Casting, Enrique Touceda. Iron Age, vol. 102, no. 20, Nov. 14, 1918, pp. 1204-1205. Possibility of obtaining thoroughly sound castings; use of chills detrimental; effect of war on industry. From paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

Molding

How Marine Cylinders Are Molded and Cast, F. H. Bell. Can. Machy., vol. 20, no. 22, Nov. 28, 1918, pp. 611-614, 7 figs. Description of method used in a Toronto plant.

Pit Molding an Intricate Condenser Casting. Foundry, vol. 46, no. 316, Dec. 1918, pp. 552-557, 10 figs. Structural difficulties, experienced more generally in light work, attended production of this 34,900-lb. casting.

Patterns

The Engineer in Relation to the Foundry, E. S. Carman. Iron Age, vol. 102, no. 20, Nov. 14, 1918, pp. 1200-1202, 13 figs. Machine designs not adapted to advanced foundry practice; comparison of correct and incorrect patterns for floor molding. From paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

Pouring

A Modern Pouring System. Iron Age, vol. 102, no. 20, Nov. 14, 1918, p. 1203, 3 figs. New type of pouring device and hand crane.

Sand

Improving Foundry Sand Mixtures, Henry B. Hanley. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1146-1148, 3 figs. Use of sand-mixing machine; time required for mixing; effect of sea coal and fireclay. From paper before Am. Fdrys. Assoc., Milwaukee, October 1918. Also in Foundry, vol. 46, no. 316, Dec. 1918, pp. 559-562, 5 figs.

Semi-Steel

Methods of Manufacturing Semi-Steel for Projectiles (Sui vari metodi di fabbricazione della ghisa per proiettili), Giulio Sirovich. Ingegneria Italiana, vol. 2, no. 4, Sept. 26, 1918, pp. 178-180.

Urgent Shell Need Found Foundries Ready. Foundry, vol. 46, no. 316, Dec. 1918, pp. 581-587, 15 figs. Manufacturing operations and practices developed in American foundries would have furnished tonnage of semi-steel shell beyond all prospective requirements.

Supervision

A Foundry Supervision System, Paul R. Ramp. Iron Age, vol. 102, no. 23, Dec. 5, 1918, pp. 1383-1385, 2 figs. Routine set of reports designed to provide quick and accurate gage of current costs and operations. From paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

See also ELECTRICAL ENGINEERING, Power Applications (Furnaces).

FUELS AND FIRING

Ash

Clinker and Ash in Fuel. Times Eng. Supp., no. 527, Sept. 1918, p. 186. Methods employed for curtailing labor entailed in removing large and hard masses of clinker.

The Fusibility of Coal Ash and the Determination of the Softening Temperature, Arno C. Fieldner, Albert E. Hall and Alexander L. Field. Department of Interior, Bureau of Mines, Bul. 129, 1918, 146 pp., 38 figs. Review of literature on subject; effect of various oxidizing, reducing, and neutral atmospheres such as are found in various parts of fuel bed on softening temperature of ash when molded in form of Seger cones; development of method for determining fusibility whereby ash is caused to soften and form slags in which iron exists in approximately same state of oxidation as when in fuel-bed clinkers.

Boiler Firing

Combustion in Its Relation to Boilers, E. A. Uehling. Power, vol. 48, no. 23, Dec. 3, 1918, pp. 804-806. Describes requirements for complete combustion and discusses combustion efficiency and absorption efficiency.

Generation of Heat and Its Absorption by Boiler, Henry Misostow. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 518-522, 4 figs., and (discussion) pp. 522-525. Conditions which will realize an efficient commercial combustion and suggestions to utilize heat indications in securing good performance in boiler room. Paper before Nat. Assn. of Stationary Engrs.

The Firing of Steam Boilers. English Mechanic & World of Sci., vol. 108, no. 2796, Oct. 25, 1918, p. 155. Report of German patent comprising an air chamber divided by two transverse partitions and placed immediately below top portion of endless chain grate. From Zeitschrift für Dampfkessel und Maschinenenbetrieb, July 5, 1918.

Coal, Combustion Characteristics

Combustion Characteristics of Coals, Joseph G. Worker. Elec. Rev., vol. 73, no. 22, Nov. 30, 1918, pp. 849-851. Combustion characteristics of coals and their influence upon choice of stoker equipment; load conditions also important factor.

Conservation

Coal Conservation. Times Eng. Supp., no. 527, Sept. 1918, p. 187. Abstract of report of Coal Conservation Committee of Ministry of Reconstruction.

England's Fuel Rationing Order. Heat. & Vent Mag., vol. 15, no. 11, Nov. 1918, pp. 17-21. Provisions of new regulation limiting supply of coal, gas and electricity to domestic consumers.

Fuel Regulation during the War, P. B. Noyes and D. M. Myers. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 481-492. Discussion by Federal Government officials before Nat. Assn. of Stationary Engrs.

Industrial Coal Economy, David Wilson. Machy. Market, no. 939, Nov. 1, 1918, pp. 19-20. Suggestions based on the experience of the author who is technical advisor to Coal Controller. Paper before Assn. of Engrs.-in-charge. (To be continued.) Also in Elecn., vol. 81, no. 2110, Oct. 25, 1918, p. 540.

Proposed Coal-Rationing Rules for the United States. Heat. & Vent. Mag., vol. 15, no. 11, Nov. 1918, pp. 21-23. Allowances designed for heating, cooking and hot-water service in residences, flats and apartment houses. Final draft of report of Committee on Fuel Conservation, Am. Soc. of Heating and Vent. Engrs.

Rational Utilization of Commercial Fuels (Sur l'utilisation rationnelle des combustibles dont dispose actuellement l'industrie). Revue Générale de l'Electricité, vol. 4, no. 14, Oct. 5, 1918, pp. 505-511. Report of the Ministry of Armament and War Manufactories. From Bulletin des Usines de Guerre, Aug. 26 and Sept. 2, 1918, pp. 137-140 and 145-147.

Gasoline

Substitute for Gasoline Tested. Motor Age, vol. 34, no. 23, Dec. 5, 1918, p. 15. Excerpts of tests made by Bureau of Standards on secret product said to be composed of inexpensive and easily obtainable materials.

Hand-Fired Plants

Fuel Economy in Hand-Fired Power Plants. Power Plant Eng., vol. 22, no. 23, Dec. 1, 1918, pp. 953-956, 4 figs. Settings, stacks and breechings. Fourth article.

Load Factor

Coal Consumption Rates in Various Central Stations and Industrial Plants. Elec. Rev., vol. 73, no. 22, Nov. 30, 1918, pp. 846-848, 2 figs. Result of study by Hydro-Electric Commission of Ontario proves superiority of large power plant and emphasizes economy of high load-factor.

Oil Fuel

California Petroleum as a Fuel Oil, Thomas J. Royer. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 525-533, 13 figs., and (discussion) pp. 533-534. Account of development; study of use in steam-boiler practice and suggestions for satisfactory operation; test in a water-works pumping station. Paper before Nat. Assn. of Stationary Engrs.

Pulverized Coal

First Pulverized Coal Installation in Western Canada, H. R. Collins. Min. & Eng. Rec., vol. 23, nos. 17 and 18, Sept. 30, 1918, pp. 177-179. Features of pulverizing plant.

Pulverized Fuel, E. R. Knowles. Steam, vol. 22, no. 5, Nov. 1918, pp. 128-133, 10 figs. Temperatures attainable; disadvantages of pulverized coal as fuel; requirements for successful burning. (Concluded.)

Pulverized Fuel in the Oneida Street Plant of the Milwaukee Elec. Ry. & Light Co., F. Dornbrook. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 535-537, and (discussion) pp. 537-539. Results obtained with trial installation. Paper before Nat. Assn. of Stationary Engrs.

Pulverizing Coal, J. Cunliffe. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 56-58. Waste resulting from burning coal in lumps; preparation, application and burning of pulverized coal.

Waste Heat

Waste Heat from Steel Furnaces, Thomas B. Mackenzie. Times Eng. Supp., no. 527, Sept. 1918, p. 195. Method of utilizing waste heat from open-hearth furnaces in generation of steam. Paper before Iron & Steel Inst.

HANDLING OF MATERIALS

Coal

Coal-Handling Plant of Virginian Railway, E. F. Case. Ry. Rev., vol. 63, no. 21, Nov. 23, 1918, pp. 731-735, 9 figs. Account of extensive additions to this railroad's plant at Sewall's Point, Va.

Excavation Material

Comparison of Excavation Haulage by Motor Trucks, Industrial Railways and Teams. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 993-996, 1 fig. Detailed cost accounts on construction of Brooklyn Army Supply Base show that trucks are more economical than teams and less economical but more flexible than railways.

Grain

Car Equipment for Loading or Unloading Grain (Installations pour le transport des grains montées sur wagons). Génie Civil, vol. 73, no. 14, Oct. 5, 1918, pp. 261-263, 11 figs. Two systems: by air pressure, and by suction.

Ore

Large Ore Storage in a Limited Space, F. L. Prentiss. Iron Age, vol. 102, no. 22, Nov. 28, 1918, pp. 1311-1313, 4 figs. Double bin system of Iroquois Iron Co. solves material-handling problems and results in short haul to skip cars.

Sand

Pneumatic Car Provides Efficient Method of Handling Sand, W. L. Whitlock. Elec. Ry. Jl., vol. 52, no. 22, Nov. 30, 1918, pp. 967-968, 5 figs. By use of new sand car, crew of regular car takes care of sand transportation which formerly required services of three additional men.

HEAT TREATING

Malleable Cast Iron

Experiments in Annealing Malleable Cast-Iron, H. E. Diller. Foundry, vol. 46, no. 316, Dec. 1918, pp. 564-566, 4 figs. Results of several laboratory experiments show that malleable iron can be annealed in tunnel furnace in 48 hours or less. From paper before Am. Foundrymen's Assn., Milwaukee, Oct. 1918.

Quenching, Steel

Warping of Steel by Repeated Quenching, J. H. Whiteley. Iron Age, vol. 102, no. 21, Nov. 21, 1918, pp. 1256-1257, 6 figs. How the metal contracts; direction of its flow; interesting features revealed by microscope. From paper before Iron and Steel Inst., London, Sept. 1918.

HEATING AND VENTILATION

Equipment

Care of Heating and Ventilating Equipment, Harold L. Alt. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 736-738, 3 figs. Down-draft furnace. Also in Power, vol. 48, no. 23, Dec. 3, 1918, pp. 801-803, 5 figs.

Factory Heating

Factory Heating, Charles L. Hubbard. Steam, vol. 22, no. 5, Nov. 1918, pp. 123-127, 9 figs. System of heating with hot water under forced circulation. (To be continued.)

Some Factory Heating Problems, B. C. Moore. Wood-Worker, vol. 37, no. 9, Nov. 1918, pp. 26-27. Considerations of the economical value of keeping a factory heated night and day.

Hot-Air Furnace

How to Improve the Hot-Air Furnace, Charles Whiting Baker. Department of Interior, Bureau of Mines, Tech. Paper 208, 20 figs. Recommends practice of adding auxiliary cold-air duct by which air supply to furnace may be taken from inside the house, instead of from outdoors, during very cold or windy weather.

House Heating

Economical Heating of Cottages and Small Houses, Frederick Grant. Domestic Eng., vol. 85, no. 5, Nov. 2, 1918, pp. 160-162, 4 figs. Suggests features of design for both hot-water and steam-heating systems.

Office-Building Heating

Fuel Economy in the Singer Building, Norman King. Power, vol. 48, no. 20, Nov. 12, 1918, pp. 710-711. Some figures on costs and economies.

Vapor Heating

Modern Practice in Vapor Heating. Heat. & Vent. Mag., vol. 15, no. 11, Nov. 1918, pp. 44-46, 5 figs. The Moline system. Sixth article.

Ventilation

A Discussion of Ventilating Practices, Charles A. Mitke. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 379-381. Analysis of working conditions as affected by ventilation; installation of mechanical ventilation. Paper before Nat. Safety Congress.

No Quarrel Necessary Between Natural and Mechanical Ventilation Advocates. Heat. & Vent. Mag., vol. 15, no. 11, Nov. 1918, pp. 37-40. Clear and well-defined field for each method depending upon required air conditions with given type of occupancy and occupation. From reply by E. Vernon Hill to newspaper article.

See also ELECTRICAL ENGINEERING, Power Applications (Heating); MECHANICAL ENGINEERING, Air Machinery (Air Conditioning).

HOISTING AND CONVEYING

Cranes

Handling Shipbuilding Material at Atlanta Shipyard. Eng. News-Rec., vol. 81, no. 23, Dec. 5, 1918, pp. 1020-1022, 8 figs. Planned for direct routing; three craneways in fabricating yard; shape shop in open; turret cranes at shipbuilding berths; assembly yard.

Hoisting and Conveying Machinery (Des appareils de manutention dans l'industrie en général), F. Séba. Revue Générale de l'Electricité, vol. 4, nos. 12 and 14, Sept. 21, and Oct. 5, 1918, pp. 423-433 and 493-504, 39 figs. Sept. 21: construction and arrangement of bridge cranes, traversing jib hoists, ceiling hoists, and foundry hoists. Oct. 5: traveling cranes with auxiliary crab, rollers, rails, gear shafts, drums, cables and grab hoists.

Some Heavy Fitting-Out Cranes—I. Fixed Cranes at Kearny and Hog Island Yards. Eng. News-Rec., vol. 81, nos. 20 and 21, Nov. 14 and 21, 1918, pp. 885-890, 6 figs.; 937-941, 6 figs. 100-ton trolley bridge spanning slipway supplemented by portal cranes; platform derrick of unusual capacity and reach uses single-motor hoisting engine at Hell Gate arch-erection plant. Nov. 21: II Cantilever and Jib Travelers at Newark Bay and Bristol; double cantilever bridge traveling along pier commands line of ships on either side; provision for extension; friction draft gear buffers; tower jib crane fitted with special safety devices.

Drums

Drum Shapes as Affecting the Mine Hoist Duty Cycle and Motor Rating, F. L. Stone. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 10, Oct. 1918, pp. 1203-1221, 22 figs. Points out that the problem of drum shape consists in varying diameter of different parts of winding drum so that load may be accelerated and retarded at beginning and end of its travel with minimum consumption of power, and gives numerical examples of performance of various drum shapes under assumed conditions.

Electric Hoisting Machines

Electric Hoisting Machines (Les machines d'extraction à commande électrique), G. Rouet. Revue Général de l'Electricité, vol. 4, no. 13, Sept. 28, 1918, pp. 451-457, 9 figs. Comparison between Léonard and three-phase types.

Ropes

Ropes for Hoisting Coal from Mines, M. W. Reed. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 388-391. Discussion concerning strength, elasticity, bending stress, starting, stopping, corrosion, clips and sockets for hoisting ropes; care and life of hoisting ropes. Paper before Nat. Safety Congress.

See also MECHANICAL ENGINEERING, Handling of Materials, Lubrication (Cranes), Machinery, Special (Hoisting Jacks)

HYDRAULIC MACHINERY

Flow of Water

A Proposed Hydraulic Experiment, Lord Rayleigh. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 315-316, 1 fig. Observation of flow of liquid between two cylinders revolving about their axes in opposite directions for the purpose of testing Froude's explanation regarding phenomena which take place when fluid passing along uniform pipe arrives at place where pipe expands.

Flow of Water in Wash Water Troughs for Rapid Sand Filters. Eng. & Contracting, vol. 50, no. 20, Nov. 13, 1918, pp. 461-462, 2 figs. From description in Cornell Civil Engineer of experiments made by Ernest C. Fortier and Frank V. Fields to determine surface curves for flow of water in wash water troughs and to develop formula for assistance of designers of troughs.

Flow of Water Through One- and One-Half-Inch Pipe and Valves, Frederick W. Greve, Jr. Purdue Univ., Bul. 1, Eng. Experiment Station, vol. 2, no. 2, July 1918, 21 pp. 16 figs. Tables and formulae for determining head losses incurred with use of pipes and valves.

Hydraulic Experiments with Valves, Orifices, Hose, Nozzles, and Orifice Buckets, Arthur N. Talbot, Fred B. Seely, Virgil R. Fleming and Melvin L. Enger. Univ. of Illinois Bul., vol. 15, no. 37, May 13, 1918, Bul. 105, 80 pp., 28 figs. Loss of hydraulic head in small valves; flow of water through submerged orifices; fire streams from small hose and nozzles; orifice bucket for measuring water.

Tides

Power from the Tides, J. O. Boving. Times Eng. Supp., no. 529, Nov. 1918, pp. 232-233, 6 figs. Design of turbines which author thinks will render utilization of tidal power economically feasible.

Water Hammer

Causes of Shock in Hydraulic Mains, Alfred Towler. Machy. Market, no. 942, Nov. 22, 1918, pp. 17-18. Broad consideration of cause and effect in principle of violent collision as determined by momentum. Paper before Leeds Assn. Engrs.

Maxima Excess Pressures Produced by Water Hammer (Etude sur les maxima de surpression dans les phénomènes de coups de bélier), Maurice Gariel. Revue Générale de l'Electricité, vol. 4, nos. 11 and 12, Sept. 21 and Oct. 5, 1918, pp. 403-411, 6 figs., and 483, 490, 4 figs. Analysis of modern theory of water hammer leads author to establish that Michaud's formula for maximum excess pressure applies to great majority of turbine installations; that Joukowski-Allievi's formula applies to conduits of uniform dimensions when opening closes in less than $2\ L/a$ (where L is length in meters and a velocity of propagation of wave); and Sparre's formula in cases of non-uniform conduits and extremely rapid shut-off. Oct. 5: Investigations of phenomena of pressure waves developed in conduit by sudden release at opening and account of experimental verification of theoretical conclusions.

Waterwheels

Principles of Waterwheel Design David R. Shearer. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 732-734, 5 figs. Some of underlying principles simply illustrated, referring particularly to relation between velocity of water and the peripheral velocity of wheel.

INTERNAL-COMBUSTION ENGINES

Heavy-Oil Engines

The Diesel Engine, Its Fuels and Uses, Herbert Haas. Automotive Eng., vol. 3, no. 9, Oct. 1918, pp. 418-424. General characteristics of oil engines; three general types; various cycles and comparison of advantages of each; comparative economies; detail of construction. (To be continued.) Also in Jl. Soc. Automotive Engrs., vol. 3, no. 5, Nov. 1918, pp. 299-308, 5 figs.

The Heavy Oil Engine, Charles E. Lucke. Int. Mar. Eng., vol. 23, no. 11, Nov., 1918, pp. 625-629 (Conclusion of article.)

The Semi-Diesel Engine. Times Eng. Supp., no. 529, Nov. 1918, p. 245. Characteristics and design.

The Semi-Diesel Oil Engine, James Richardson. Engineering, vol. 106, no. 2756, Oct. 25, 1918, pp. 461-464, 12 figs. Review of many types of semi-Diesel engines. Paper before Diesel Engine Users' Asso., Oct. 24, 1918.

High-Speed Engine

Modern Types of Engines, Harry R. Ricardo, Machy. Market, no. 941, Nov. 15, 1918, pp. 17-18. Features of high-speed engine design and points upon which designers have concentrated their attention. Paper before North-East Coast Instn. of Engrs. & Shipbuilders. (To be continued.) Also in Int. Mar. Engr., vol. 23, no. 11, Nov. 1918, pp. 650-651.

Magnetos

Operation of Internal-Combustion-Engine Magnetos (Sul Funzionamento dei magneti di accensione dei motori a scoppio), Emilio Bilfi. L'Elettrotecnica, vol. 5, nos. 22, 24 and 28, Aug. 5 and 25, Oct. 5, 1918, pp. 302-306, 326-332 and 386-392, 26 figs. Aug. 5 and 25: theory of the magneto-generator. Oct. 5: theory of formation of spark in secondary coil. (To be continued.)

Marine Engines

Two versus Four-Cycle Internal Combustion Marine Engines, Giovanni Chiesa. Engineering, vol. 106, no. 2757, Nov. 1, 1918, pp. 482-486, 6 figs. Purpose of article is to coordinate arguments which have been alleged for and against both types in their best form of construction and to endeavor to draw conclusion after careful consideration of all points of question.

Mixture

Mixing the Mixture, Robert Miller. Motor Boat, vol. 15, no. 22, Nov. 25, 1918, pp. 11-14, 6 figs. Points out importance of securing uniform mixture in cylinder in order to secure chemical combination and considers the problem of direct injection.

Pistons

Piston Design, Harry R. Ricardo. Automobile Engr., vol. 8, no. 119, Oct. 1918, pp. 274-278, 12 figs. Design in which connection between ring-carrying portion of piston and slipper surface is severed, so that heat can only be conducted to slipper surfaces by way of main webs, these being so constructed that heat from crown is distributed evenly over surface of slippers. Also in Autocar, vol. 41, no. 1201, Oct. 26, 1918, pp. 409-410, 3 figs.

Spark Plugs

Note on the Effect of Temperature on the Resistances of Spark Plug Insulations, J. D. Morgan. Engineering, vol. 106, no. 2758, Nov. 8, 1918, pp. 513-514, 3 figs. Description of an investigation.

See also AERONAUTICS, Engines; MECHANICAL ENGINEERING, Motor-Car Engineering (Engines, Gasoline, Kerosene, Kerosene Burning).

LUBRICATION

Cranes, Electric

Electric Crane Lubrication, Geo. R. Rowland. Lubrication, vol. 5, no. 12, Oct. 1918, pp. 2-10, 10 figs. Ring oiling system which consists of oil reservoir and brass ring attached to and revolving with shaft.

Cutting Tools

Cutting Lubricants and Cooling Liquids. Shipbuilding & Shipping Rec., vol. 12, no. 19, Nov. 7, 1918, pp. 445-446. Enumeration of factors upon which selection of suitable cutting lubricant or cooling liquid depends and suggestions in regard to their manipulation. From report issued by Advisory Council of Department of Scientific & Indus. Research.

Economy

Lubricant Economy, D. Street. Can. Machy., vol. 20, no. 22, Nov. 28, 1918, p. 617. Necessity for practicing economy and suggestions for reducing waste.

Steam Cylinders

Problems of Steam Cylinder Lubrication (III), W. F. Osborne. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 414-416. Factors affecting operation and lubrication of compound engines.

See also MECHANICAL ENGINEERING, Motor-Car Engineering (Lubrication).

MACHINE ELEMENTS AND DESIGN

Bearings

Saving Power by Efficient Bearings, F. H. Lenox. Textile World Jl., vol. 54, no. 23, Dec. 7, 1918, pp. 91-95, 4 figs. Equipment method and results of experiments to determine power required to overcome friction of shaft bearings.

Bolts and Screws

S. A. E. Standard Screws and Bolts. Jl. Soc. Automotive Engrs., vol. 3, no. 5, Nov. 1918, pp. 333-335, 1 fig. Brief account of development of standards and comparison of standard screw-thread pitches used in five inch-systems most generally adopted in American and British practice,—B. W. S., B. S. F., U. S. S., S. A. E. Reg., S. A. E. Fine.

Crankshafts

Problems of Crankshaft Design, Otto M. Burkhardt. Aerial Age, vol. 8, no. 7, Oct. 28, 1918, pp. 376-379, 15 figs. Mathematical analysis of three groups of forces necessary to induce and maintain speeds of 3000 r.p.m. or more: pressures due to gaseous mixture, inertia forces and centrifugal forces. Paper before Eng. Soc. of Buffalo.

Gears

The Internal Gear. Pamphlet published by Fellows Gear Shaper Co., 92 pp., 55 figs. Popular presentation of the comparative tooth action of internal and external gear teeth, together with directions for cutting, and samples of applications.

See also MECHANICAL ENGINEERING, Internal-Combustion Engines (Pistons), Power Transmission.

MACHINE SHOP

Tool Making

Tooling Up Single Spindle Automatics and Lathes. Can. Machy., vol. 20, no. 19, Nov. 7, 1918, pp. 536-537, 6 figs. Operations for British 101 fuse body.

Grinding

Grinding; Its Utility in the Modern Shop, D. Street. Can. Machy., vol. 20, no. 22, Nov.

ATLAS BALLS
FOR MACHINE TOOL BEARINGS
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ROUND AND TRUE TO SIZE WITHIN 1/10,000 INCH
ATLAS BALL COMPANY-PHILADELPHIA,U.S.A.

28, 1918, p. 623. Convenience of substituting grinding for tooling in certain machine operations.

Belting

Belting Speeds; Saw Speeds; Bearing Alloys, G. F. Cosgrove. Wood-Worker, vol. 37, no. 9, Nov. 1918, pp. 28-29. Account of experiments made with gang ripping machines with saws located above stock to be ripped, feed being by means of a grooved traveling bed which carries the stock beneath saws.

Drill Sharpening

Central Plant for Sharpening Drill Steels Saves Money in Quarrying. Eng. News-Rec., vol. 81, no. 21, Nov. 21, 1918, pp. 929-930, 3 figs. Sharpening shop with two men replaces five smithies; steel conveyor, oil-fired furnaces and concrete quenching vat.

Gages

Making Thread Gages, T. H. Fenner. Can. Machy., vol. 20, no. 19, Nov. 7, 1918, pp. 529-532, 7 figs. Description of plant and methods of a Canadian firm.

Milling

Continuous Milling, A. Thomas. Automobile Engr., vol. 8, no. 119, Oct. 1918, pp. 296-298, 12 figs. Notes on operation of Becker machine.

Operation

Scientific Organization of the Machine Shop (Organisation Scientifique de l'usinage), P. Denis. Génie Civil, vol. 73, nos. 12, 13 and 14, Sept. 21, 28 and Oct. 5, 1918, pp. 227-230, 246-251 and 268-271, 23 figs. Methodical execution of turning, countersinking and drilling. Sept. 21: selection of most economical cutting speed by construction of individual tool curves showing cutting speed against volume of material removed by tool at that speed before it needs resharpening. Sept. 28: further study of tool curves and their utilization in determining the most effective thermal treatment for tools used in cutting operations. Oct. 5: numerical illustrations and résumé of conclusions reached.

Punch Press

Safe Punch Press Operation, W. W. Roach. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 231-233. Discusses installation and use of mechanical guards, introduction of safe practices and education of press operators. From Proc. Seventh Annual Safety Congress.

Square Holes

Generating a Square Hole with a Gear-Shaper Cutter, Douglas T. Hamilton. Am. Mach., vol. 49, no. 21, Nov. 21, 1918, pp. 949-950, 2 figs.

Tool Department

Supervising a Large Tool Department, C. W. Starker. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 481-486. Step toward greater economy in tool department. Methods developed in tool department to coordinate requirements and minimize tool expense.

Tractor

Manufacturing the Caterpillar Tractor, Frank A. Stanley, Am. Mach., vol. 49, nos. 20, 22 and 23, Nov. 14, 28 and Dec. 5, 1918, pp. 897-901, 14 figs; 977-980, 9 figs. and 1040-1042, 12 figs. Milling work. Nov. 28: making connecting rods; Dec. 5: small parts.

See also MECHANICAL ENGINEERING, Lubrication (Cutting Tools), Welding; RAILROAD ENGINEERING, Shops.

MACHINERY, METAL-WORKING

Boring Bar

Making Boring Bars for Big Guns, M. E. Hoag. Am. Mach., vol. 49, no. 22, Nov. 28, 1918, pp. 987-988, 4 figs. Describing boring of hole 42 feet long 1¼ inches in diameter.

Grinder

Heald Cylinder Grinder. Am. Mach., vol. 49, no. 23, Dec. 5, 1918, pp. 1053-1054, 2 figs. Description of machine built by Heald Machine Co., Worcester, Mass., with principal dimensions.

Lathe

Amalgamated Shell-Turning Lathe. Am. Mach., vol. 49, no. 19, Nov. 7, 1918, p. 869, 1 fig. Short description with principal dimensions.

Slotting Machine

A New Slotting Machine of the Milling Type, J. V. Hunter. Am. Mach., vol. 49, no. 21, 1918, pp. 953-956, 9 figs. Description with principal data of new machine tool brought out by Racine Tool and Machine Co., Racine, Wis.

MACHINERY, SPECIAL

Chain

The Manufacture of Diamond Transmission Chain, J. V. Hunter. Am. Mach., vol. 49, nos. 19 and 23, Nov. 7 and Dec. 5, 1918, pp. 845-848, 9 figs, and 1027-1031, 16 figs. Making rollers; Dec. 5: Making block chain.

Rapid Development of Electric Cast Steel Anchor Chain Industry, W. L. Merrill. Int. Mar. Eng., vol. 23, no. 11, Nov. 1918, pp. 630-634, 8 figs Electric welding versus hand welding; tests and results. Abstract of article in Gen. Elec. Rev.

Clocks

Studies in Clocks and Time-Keeping: No. 1. Theory of the Maintenance of Motion, R. A. Sampson. Proc. Roy. Soc. of Edinburgh, vol. 38, parts 1 and 2, session 1917-1918, pp. 75-114, 11 figs., and 169-218. Practical details of three clocks, Riefler, synchronome, and Cottingham; theoretical discussions on maintenance of motion, air resistance, barometric error, escapement error, temperature compensation, and other points connected with exact timekeeping. No. 2: Tables of the Circular Equation.

Evaporators

Lillie Multiple Evaporator. Steam, vol. 22, no. 5, Nov. 1918, pp. 142-143, 3 figs. Evaporator in which liquid is spread over heating surfaces in thin films.

Hoisting Jacks

Hydraulic Car Lift Gives Increased Output to Shops, Homer MacNutt. Elec. Ry. Jl., vol. 52, no. 21, Nov. 23, 1918, pp. 927-928, 4 figs. Description with illustrations of hydraulic hoisting jack.

Quarrying Machines

Labor-Saving Methods and Machines in Limestone Quarrying. Eng. & Contracting, vol. 50, no. 21, Nov. 20, 1918, pp. 478-479. From pamphlet by Oliver Bowles issued by U. S. Bureau of Mines.

Quenching Machine

A Quenching Machine for Hardening Small Drawing Dies. Am. Mach., vol. 49, no. 23, Dec. 5, 1918, pp. 1045-1046, 4 figs. Description of machine developed by S. A. Potter Tool and Machine Works, 70 East 130th St., New York.

Road Finisher

Road Finisher Produces Denser Concrete. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, p. 34, 2 figs. Machine which subjects mixture to continuous agitation by tamper.

Scales

Modern 150-Ton Track Scale Now in Use, Frank C. Perkins. Can. Machy., vol. 20, no. 19, Nov. 7, 1918, pp. 544-547, 9 figs. Mechanism of design in which plate-steel fulcrums are used.

Screens, Gravel

Comparative Analysis of Gravel Screens, Raymond W. Dull. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 21-23, 10 figs. Considers gravity, cylinder, overhung conical, and inclined conical types.

Shorthand Machine

Manufacturing a Shorthand Machine, M. E. Hoag. Am. Mach., vol. 49, nos. 19, 20 and 21, Nov. 7, 14 and 21, 1918, pp. 853-854, 8 figs., 902-904, 8 figs, and 946-947, 8 figs. Describing mechanical features of machine, some tools and dies. (First article.)

Tool Setter

Alignment-Tester and Microscopic Tool-Setter. Engineering, vol. 106, no. 2754, Oct. 11, 1918, pp. 398-399, 7 figs. Description of an instrument constructed by Cambridge Scientific Instrument Company, Limited, Cambridge.

See also CIVIL ENGINEERING, Roads and Pavements (Mixers).

MATERIALS OF CONSTRUCTION AND TESTING OF MATERIALS

Asphalt

Standardization of Required Consistency for Asphalt, J. R. Draney. Contract Rec., vol. 32, no. 46, Nov. 13, 1918, p. 910. Quotes present variations and suggests possible specifications.

Boiler Plate

Materials of Steam Boiler Construction, A. J. Dixon. Boiler Maker, vol. 18, no. 11, Nov. 1918, pp. 317-319. Action of carbon in boiler plate; dangers of free use of cast iron; laminar structure of wrought iron. From Power.

Cracks

Prevention of Season and Corrosion Cracks, W. B. Price. Am. Mach., vol. 49, no. 19, Nov. 7, 1918, pp. 848-850, 7 figs. Paper before Am. Soc. for Testing Materials, Atlantic City, June 1918.

Monel Metal

Note on Monel Metal, John Arnott. Engineering, vol. 106, no. 2756, Oct. 25, 1918, p. 451, 3 figs. Composition, microstructure, strength of rolled materials, effect of annealing strength at high temperature, use.

Silica Brick

Silica Brick Tests. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, p. 62. Brief report of experiments conducted in France which revealed that notable quantities of iron oxide do not sensibly lower fusing point of silica, even when lime is present.

See also CIVIL ENGINEERING, Materials of Construction; AERONAUTICS, Materials of Construction.

MEASUREMENTS AND MEASURING APPARATUS

Depth Gage

A Micrometer Depth Gauge, C. H. Copland. Model Engr., vol. 39, no. 914, Oct. 31, 1918, pp. 239-240, 6 figs. General arrangement and details of gage intended for use on munition or other fine work.

Hardness

The Institution of Mechanical Engineers. Engineering, vol. 106, no. 2756, Oct. 25, 1918, pp. 469-472, 5 figs. Discussion of three papers on hardness testing, "A Law Governing the Resistance to Penetration of Metals When Tested with a 10-mm. Steel Ball; and a New Hardness Scale in Energy Units," by Prof. C. A. Edwards, "The Value of the Indentation Method in the Determination of Hardness," by R. G. C. Batson, and "The Ludwik Hardness Test," by W. C. Unwin, all read at meeting of Inst., Oct. 1918.

The Ludwik Hardness Test, W. C. Unwin. Engineering, vol. 106, no. 2756, Oct. 25, 1918, p. 478. Paper before Inst. of Mech. Engrs., Oct. 1918.

The Resistance of Metals to Penetration Under Impact, C. A. Edwards. Engineering, vol. 126, no. 3276, Oct. 11, 1918, pp. 314. Abstract of paper before Inst. of Mech. Engrs., June 1918.

Value of the Indentation Method in the Determination of Hardness, R. G. C. Batson. Engineering, vol. 106, no. 2756, Oct. 25, 1918, pp. 475-477, 6 figs. Paper before Inst. of Mech. Engrs., Oct. 1918.

Heat Measurement

Heat-Measuring Instruments, C. E. Clewell. Am. Mach., vol. 49, no. 23, Dec. 5, 1918, pp. 1021-1025, 12 figs. Principal types of pyrometers; features connected with their use; typical uses; cases of practical installations of pyrometers illustrated.

Indicators

Indicator Cord Connections, R. T. Strohm. Southern Engr., vol. 30, no. 4, Dec. 1918, pp. 40-41, 7 figs. Collection of methods used by engineers to connect cord to reducing motion.

Minimeter

The Minimeter for Fine Measuring, Frank C. Perkins. Can. Machy., vol. 20, no. 21, Nov. 21, 1918, pp. 592-593, 5 figs. Principle and forms of Hirth apparatus for measuring threads, balls, cylindrical parts and grooves, also for inside measuring of various diameters.

Permeability

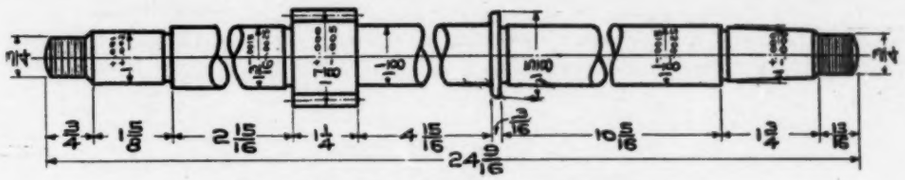
Determination of Permeability of Balloon Fabrics, Junius David Edwards. Aeronautics, vol. 15, no. 261, Oct. 16, 1918, pp. 358-364, 7 figs. Theory of process; volume-loss methods; penetration methods; experimental apparatus; effect of experimental conditions on apparent permeability; operating directions and calculations. From Aviation & Aeronautical Eng.

Variance

Variance of Measuring Instruments and Its Relation to Accuracy and Sensitivity, Frederick J. Schlink. Jl. Franklin Inst., vol. 186, no. 6, Dec. 1918, pp. 743-747. Abstract of notes from U. S. Bureau of Standards.

Viscosity

On the Measurement of the Viscosity of Liquids (Sur la mesure de la viscosité des huiles), C. Chéneveau. Journal de Physique, vol. 7, May-June 1917, pp. 109-114, 1 fig. Apparatus for measuring absolute viscosity by application of Poiseuille's law.



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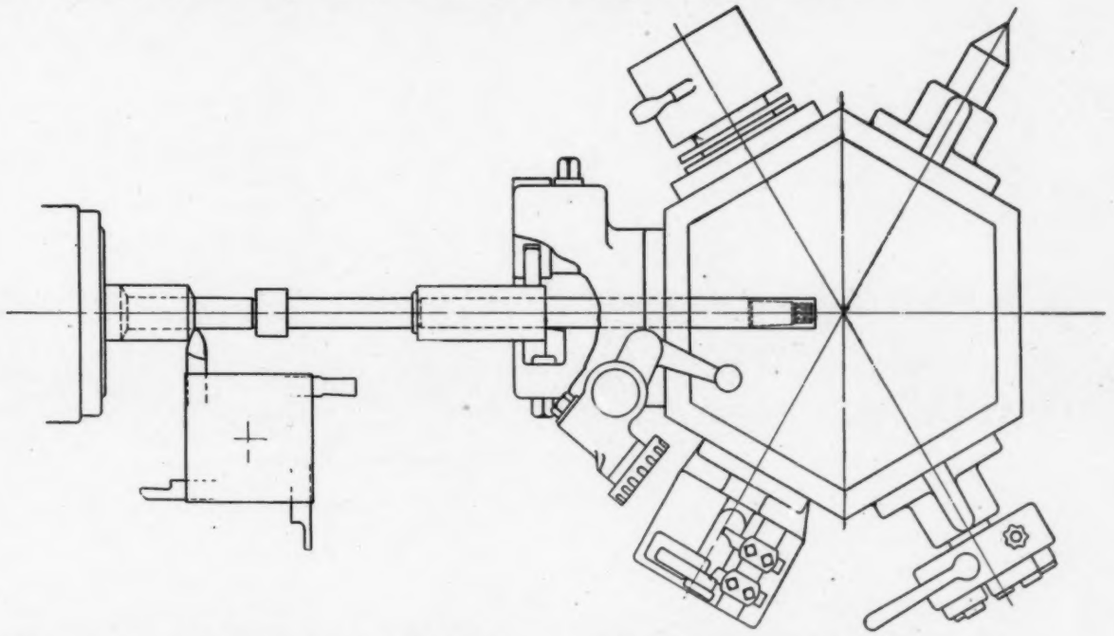

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2nd Operation:—Turn the ¾ in. diameter.
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4th Operation:—Turn the 1 in. tapered diameter with taper attachment and nick with square turrent cutter.
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MECHANICS

Beams

Curved Beams, James J. Guest. Proc. Roy. Soc., vol. 95, no. A665, Sept. 2, 1918, pp. 1-21, 6 figs. Determination of stresses produced by bending moment in uniform curved beams of several special sections; method of estimating maximum stress applicable to sections considered and approximately to any other section not having extraordinary features.

The Buckling of Deep Beams, J. Prescott. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 297-314, 7 figs. Attempt to develop mathematical theory of side buckling of beam having a depth much greater than its breadth by assuming buckling has actually occurred and finding value of couples at end which will maintain buckled state of beam.

Elasticity

Elastic Solids Under Body Forces, D. N. Mallik. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 321-326. Derives from equation of equilibrium of isotropic solid under body forces mathematical expression for its displacement.

Theory of Elastic Phenomena Taking Place in Punching and Drawing of Plastic Blocks (Théorie du poinçonnage et de l'écoulement des blocs plastiques: phase elastique de ces phénomènes), J. Boussinesq. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 15, Oct. 7, 1918, pp. 505-510. Studies general case of cylindrical block. Supplement to four previous communications (Comptes rendus, vol. 167, July 29, Aug. 5, 12, 19, pp. 186, 221, 253, 285) on the verification of Trosca's formulæ.

Shafts

The Periods of Lateral Vibration of Loaded Shafts—The Rational Derivation of Dunkerley's Empirical Rule for Determining Whirling Speeds, H. H. Jeffcott. Proc. Roy. Soc., vol. 95, no. A666, Oct. 7, 1918, pp. 106-115. Derives Dunkerley's rule by investigating conditions in uniform and light shaft freely supported by bearings at its ends, and loaded with discrete masses m_1, m_2, ... m_n, of negligible moment of inertia at definite points along its length. Then by considering several successively higher whirling speeds of loaded shaft, the degree of approximation of Dunkerley's rule is determined.

Springs

A New Theory of Plate Springs, David Landau and Percy H. Parr. Jl. Franklin Inst., vol. 186, no. 6, Dec. 1918, pp. 699-721, 8 figs. Mathematical study of effect of tapering ends of leaves on strength of spring. Continued from vol. 185, April 1918, p. 481. (To be continued.)

Tubes

Contribution to Our Knowledge on Calculation of Stresses in Tubes (Bidrag till Kännedom om tubers beräkning), Folke L:son Grange. Teknisk Tidskrift, Väg—och Vatten-Byggnadskonst, year 48, no. 10, Oct. 1918, pp. 145-147, 4 figs.

MOTOR-CAR ENGINEERING

Design

Aeronautical Experience Will Profoundly Affect Motor Car Practice, A. A. Remington. Automotive Ind., vol. 39, no. 18, Oct. 31, 1918, p. 776. Emphasizes necessity for greater standardization and more research work. Presidential address before British Instn. Automobile Engrs.

Post-War Chassis. Automobile Engr., vol. 8, no. 119, Oct. 1918, pp. 279-280. Possible effects of aircraft engine experience and other factors bearing upon design. (To be continued.)

Engines, Gasoline

The "American" Sleeve-Valve Motor. Auto, vol. 23, no. 44, Nov. 1, 1918, pp. 820-822, 6 figs. How sleeves are operated; suggestion to overcome tendency not to get rid of exhaust, by offsetting forward sleeve exhaust port from its present direct opposition to inlet and narrowing and deepening both it and others corresponding in cylinder wall and in head.

Engines, Kerosene

Beaver Kerosene Tractor Engines. Automotive Industries, vol. 39, no. 20, Nov. 14, 1918, pp. 839 and 862. 2 figs. Horsepower and torque curves of 4¾ × 6-in. engine and record of 5-hr. endurance test on full-open throttle at 900 r.p.m.

Fuel Consumption

Tests for Reducing Fuel Consumption on Motor Vehicles (Forsog paa Besparelse af Brændselsolie ved Automobilkorsel), Paul Bergsoe. Ingenioren, year 27, no. 85, Oct. 23, 1918, pp. 557-558.

Gas Fuel

Coal Gas for Motor Vehicles. Times Eng. Supp., no. 527, Sept. 1918, p. 187. Modifications for running under compressed charges introduced by London General Omnibus Co.

Kerosene Burning (see Engines, Kerosene)

Kerosene Vaporization, L. E. French. Automotive Industries, vol. 39, no. 20, Nov. 14, 1918, p. 845, 2 figs. Apparatus embodying tube and hot-spot systems of vaporizing heavy fuel for internal-combustion engines, the two effects being automatically balanced.

The Bellem-Bregeras Kerosene Atomizer. Auto, vol. 23, no. 45, Nov. 8, 1918, p. 845, 2 figs. Theoretical value and practical performance results.

Lubrication

Lubrication and Fuel Tests, P. J. Dasey. Automotive Ind., vol. 39, no. 21, Nov. 21, 1918, pp. 875-877, 4 figs. Deals with tests made on a Buda tractor-type engine. Devorik's new synthetic gasoline. Paper before section of Soc. Automotive Engrs.

Single-Feed System Oils Car from Seat. Automotive Ind., vol. 39, no. 17, Oct. 24, 1918, p. 719. Multiple-plunger hand pump and reservoir constructed to supply oil under pressure to all points on chassis.

Steam Vehicles

Solid Fuels for Steam Vehicles. Motor Traction, vol. 27, no. 709, Oct. 2, 1918, pp. 243-244. Review of tests conducted by coal controller to prove that other fuels than Welsh coal could be used.

Tractors

Heider Friction Drive Tractor. Automotive Industries, vol. 39, no. 20, Nov. 14, 1918, pp. 831-832, 4 figs. Friction drive which enables a considerable number of tractor speeds and belt speeds to be obtained without use of shifting gears .

Wheels

Front Wheel Wobble, Walter Boyle. Motor Traction, vol. 27, no. 712, Oct. 23, 1918, pp. 305-306, 2 figs. Sketch of method to give trailing effort to front wheels by tilting steering heads.

See also CIVIL ENGINEERING, Roads and Pavements (Maintenance), (Wood Roads); ORGANIZATION AND MANAGEMENT, Transportation; MECHANICAL ENGINEERING, Fuels and Firing (Gasoline), Internal-Combustion Engines; AERONAUTICS, Auxiliary Services.

PIPE

Tile

Tile Pipe Versus Iron Pipe for Drains, Osborne Smith. Contract Rec., vol. 32, no. 44, Oct. 30, 1918, p. 873. Brief account of author's experience and suggestions in regard to jointing.

POWER GENERATION

Canada

Utilizing Canada's Water Powers, J. B. Challies. Can. Mfr., vol. 38, no. 8, Aug. 1918, pp. 25-27. Future possibilities and requirements for their realization. From paper before Can. Soc. Civil Engrs.

POWER PLANTS

Boiler Inspection

Ontario Boiler Inspection Office. Power, vol. 48, no. 20, Nov. 12, 1918, pp. 698-699, 13 figs. Examples of dangerous conditions found in boilers described and illustrated.

Boiler Operation

Boiler Room Efficiency, A. H. Blackburn. Power Plant Eng., vol. 22, no. 22, Nov. 15, 1918, pp. 919-920. Analysis of fuel; losses in boiler room; instruments; coal handling. Abstract of paper before Annual Convention of Smoke Prevention Assn.

Economic Operation of Steam Turbo-Electric Stations, C. T. Hirshfeld and C. L. Karr. Department of Interior, Bureau of Mines, Tech. Paper 204, 29 pp., 5 figs. Analysis of methods used in boiler room for producing steam required and distributing load between main units available. Discussion of economic source for auxiliary power and conclusion that auxiliary power in excess of that obtainable with exhaust steam absorption can be procured from main generators in electrical form at lower thermal cost than in any other way.

Economical Working of Boiler Plant, P. D. Kirkman. Machy. Market, no. 942, Nov. 22, 1918, p. 18. List of modern efficiency apparatus and of items to be studied in connection with waste and efficiency. Address to Manchester Branch of British Assn. of Textile Managers.

Economy in Boiler Operation, Thomas M. Gray. Southern Engr., vol. 30, no. 4, Dec. 1918, pp. 42-43, 1 fig. Advantages and disadvantages of high furnace temperatures; conditions produced by forcing boilers considerably beyond their rating; sampling and analyzing of flue gases.

Boiler Settings

Boiler Setting Radiation and Air Leakage, E. S. Hight. Elec. World, vol. 72, no. 21, Nov. 23, 1918, pp. 974-975, 1 fig. Results of experiments to determine best method of covering boiler settings to bring about reduction in radiation and escape of air; type of covering which saves $1000 per 500-hp. battery per year.

Central Stations

A Kilowatt Hour and the Coal Required to Produce It, B. H. Blaisdell. Elec. Eng., vol. 52, no. 2, Aug. 1918, pp. 26-28. Waste inherent in present system of generating power and remarks on some of the losses due to imperfect manipulation. Paper before Manila Section of Nat. Elec. Light Assn.

Increasing the Economy of Central-Station Operation, J. W. Andree. Elec. World, vol. 72, no. 19, Nov. 9, 1918, pp. 881-882. Overhauling water conduits and prime movers; burning natural gas to save fuel oil; other proved methods.

Coke-Oven Plants

Power Plants at By-Product Coke-Ovens, F. E. Harris. Ir. & Cl. Trds. Rev., vol. 96, no. 2617, April 26, 1918, pp. 450-452, 2 figs. Discusses requirements and how to obtain satisfactory results.

Condensers

Condensers and Condenser Engineering Practice, D. D. Pendleton. Power, vol. 48, no. 20 and 21, Nov. 12 and 19, 1918, pp. 720-722 and 756-757. Abstract of paper presented at twelfth annual convention of Assn. of Iron and Steel Elec. Eng., Baltimore, Sept. 1918.

Cost

Improving Factory Steam Plants (V), H. A. Wilcox. Power Plant Eng., vol. 22, no. 22, Nov. 15, 1918, pp. 915-918, 2 figs. Test to determine proper division of costs; schedule of operation for power department.

Economizers

Exact Data on the Running of Steam Boiler Plants, D. Brownlie. Engineering, vol. 106, no. 2757, Nov. 1, 1918, pp. 481-482. Economizers. First article.

Efficiency

Steam Plant Efficiency. Coal Trade Jl., year 50, no. 49, Dec. 4, 1918, pp. 1433-1434. Suggestions addressed operating officers, superintendents, chief engineers, motive power department officials and men in charge of stationary power, heating and pumping plants by U. S. Railroad Administration.

Exhaust Steam

Maintenance of a Proper Heat Balance, R. N. Ehrhart. Power, vol. 48, no. 20, Nov. 12, 1918, pp. 692-694, 4 figs. Describing hand and automatic control of exhaust steam from auxiliaries so that quantity of exhaust steam available for feed heating may at all times be proportioned to load on main units, thus preventing waste of exhaust at light loads.

High-Pressure Steam

The Use of High-Pressure and High-Temperature Steam in Large Power Stations, J. H. Shaw. Inst. E. E., Nov. 1918, pp. 1-10, 5 figs. From the point of view of the engineer interested in the generation of electricity. Also in Machy. Market, no. 942, Nov. 22, 1918, pp. 19-20.

Individual Plants

New General Electric Steam Turbine Shop, F. L. Prentiss. Iron Age, vol. 102, no. 20, Nov. 14, 1918, pp. 1195-1199, 6 figs. Construction and other features in large plant designed for heavy machine work; production methods followed.

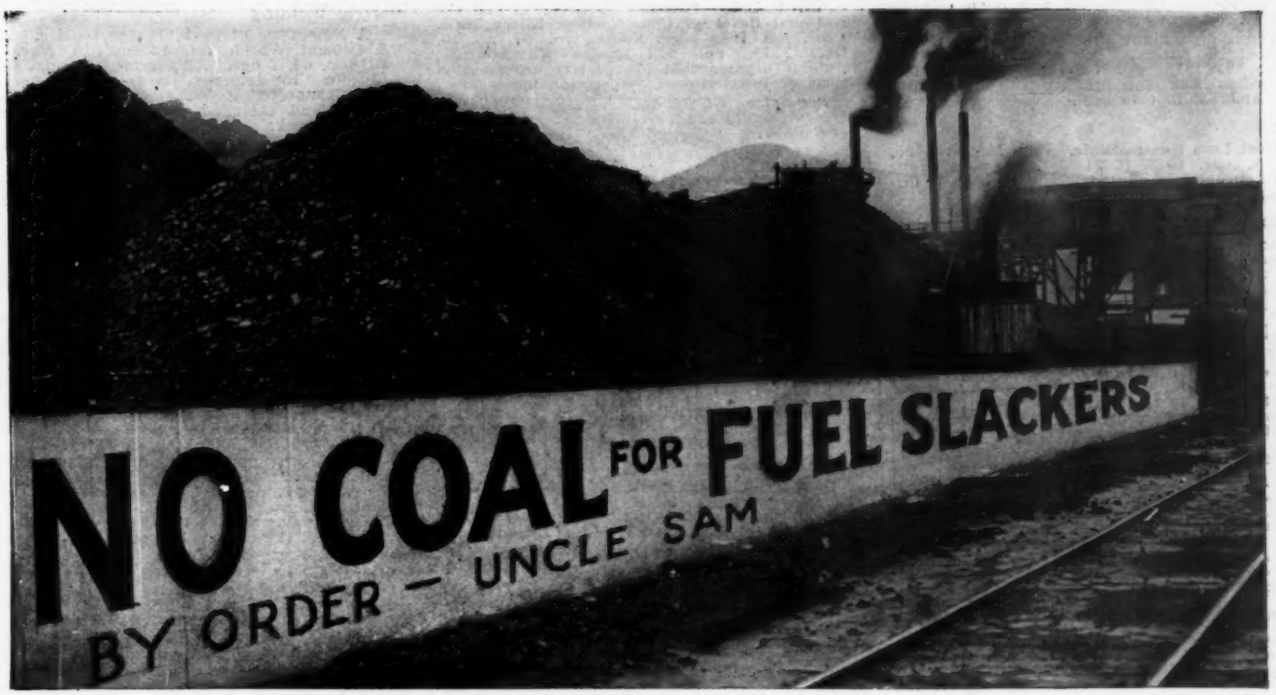
Plant Arrangement and Cost of Construction. Elec. World, vol. 72, no. 19, Nov. 9, 1918, pp. 888-890, 3 figs. Features of latest station of Turners Falls Power & Electric Co., may become one of most important steam plants in New England. (Second article.)

Instruments

Power Plant Management—(IV) The Use of Instruments, Robert June. Refrigerating World, vol. 53, no. 10, Oct. 1918, pp. 23-26, 7 figs. Importance of using recording instruments; graphs showing draft required at different combustion rates for various fuels, loss due to unconsumed carbon contained in CO_2 in flue gases, and loss due to heat carried away by chimney gases for varying percentages of CO_2.

Power Industry

Conditions in the Power Industry, Ludwig W. Schmidt. Power, vol. 48, no. 23, Dec. 3,



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1918, pp. 798-800. Digest of reports of U. S. consuls on power situation in various parts of world and influence of war upon this industry.

The Power Plant Problem in South China, Harold B. Wilson. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 747-748. Only pioneer work has been done and there is opportunity for America in this field.

Scale

Heat Loss Due to Scale. Can. Mfr., vol. 38, no. 8, Aug. 1918, p. 31, 1 fig. Chart showing approximate annual loss with coal at different prices.

Screens, Water

Screening Condensing Water Efficiently and Economically, Henry J. Edsall. Steam, vol. 22, no. 5, Nov. 1918, pp. 133-137, 7 figs. Describes traveling screens with automatic cleaning features.

Stack Losses

Steam Plant Efficiency, Henry Kreisinger. Coal Trade Jl., year 50, no. 47, Nov. 20, 1918, pp. 1392-1393. Causes of high ash loss; methods of determining stack losses; causes of large excess of air and remedy. (To be concluded.)

Temperature Regulation

Automatic Temperature Regulation as a Fuel Conservation Measure. Heat. & Vent. Mag., vol. 15, no. 11, Nov. 1918, pp. 40-43. Advanced report of a Committee on Automatic Heat Control, as furnished to Fuel Administration. For presentation at annual meeting of Am. Soc. of Heating and Vent. Engrs., New York, Jan. 1918.

Water Softening

Home-Made Water Softening Plant, H. D. Odell. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 728-731, 3 figs. Description of home-made water-softening plant and experiences with it.

Wire-Making Plants

Power Generation for Wire Making. Power Plant Eng., vol. 22, no. 22, Nov. 15, 1918, pp. 907-914, 15 figs. Description of plants of John A. Roebling Sons Co., Trenton, N. J.

See also ELECTRICAL ENGINEERING, Generating Stations.

POWER TRANSMISSION

Gears

Saving Coal at the Gear and Wheel Tread, C. W. Squier. Elec. Ry. Jl., vol. 52, no. 20, Nov. 16, 1918, pp. 876-878, 7 figs. Discussion of losses in gearing; showing how correct gear ratio with low armature speed will save power; comparing gearless and geared motors and two and four motor equipments.

PRODUCER GAS

Machine Shop for Gas Producer Work. Iron Age, vol. 102, no. 23, Dec. 5, 1918, pp. 1373-1378, 14 figs. Features of new plant of Smith Gas Engineering Co., Dayton, Ohio. Producer operation for power purposes.

REFRIGERATION

Ammonia Compression

Improving a Refrigerating Plant, E. W. Miller. Refrigerating World, vol. 53, no. 9, Sept. 1918, pp. 25-26, 1 fig. Account of work done in installation consisting of a 50-ton horizontal double-acting compressor, a 150-hp. combination fire- and water-tube boiler, pumps and a 50-kw. generating unit.

The Ammonia Compression Refrigerating System (XXII), W. S. Doan. Refrigerating World, vol. 53, no. 9 and 10, Sept. and Oct. 1918, pp. 31-32, 3 figs. and 31-32, 3 figs. Troubles likely to develop in piston-rod stuffing box and manner of overcoming them.

Ammonia Leakage

Finding "Lost" Ammonia in Refrigerating Plants, E. W. Miller. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 734-735. Common causes for leakage of ammonia.

Ice Plants

Ice Plant Troubles, E. W. Miller. Southern Engr., vol. 30, no. 4, Dec. 1918, pp. 48-50. Outline of conditions in actual case and suggestions on economical operation.

Operation

Making a Neglected Refrigerating Plant Give Capacity, E. W. Miller. Power, vol. 48, no. 23, Dec. 3, 1918, pp. 810-811, 1 fig. What was done to make comparatively new plant give rated capacity.

Small Machines

Small Refrigerating Machines, John E. Starr. Refrigerating World, vol. 53, no. 9, Sept. 1918, pp. 11-12. Difficulties presented by small machines in addition to the difficulties existing in all machines.

RESEARCH

The National Engineering Societies and the National Research Council, Geo. Ellery Hale. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 10, Oct. 1918, pp. 1223-1236. War duties; present organization of research information service; international coöperation in research.

See also ELECTRICAL ENGINEERING, Measurements and Tests (Official Testing Laboratories).

STANDARDS AND STANDARDIZATION

Metric System

The Metric System, Harry Allcock. Surveyor, vol. 54, no. 1399, Nov. 8, 1918, p. 227. Criticism of arguments presented by Committee on Commercial and Industrial Policy After the War in their report against early introduction of metric system.

Use of the Metric System in the United States. Sci., vol. 48, no. 1248, Nov. 29, 1918, pp. 540-541. Resolution adopted by United States Section of International High Commission regarding use of metric system in U. S. in order to foster Pan-American commercial relations.

Screw Threads

Inaugural Presidential Address to the Manchester Association of Engineers. Steamship, vol. 20, no. 353, Nov. 1918, pp. 112-115. Consideration of various aspects of problem of standardizing screw threads and other industrial products.

STEAM ENGINEERING

Boilers

Safe Working Pressure for Steam Boilers, H. F. Gauss. Power, vol. 48, no. 22, Nov. 26, 1918, pp. 772-774. Simple treatment dealing with efficiency of riveted joints, bursting and safe working pressures for boilers, and permissible pressure on stayed surfaces.

How to Design and Lay Out a Boiler (I), Wm. C. Strott. Boiler Maker, vol. 18, no. 11, Nov. 1918, pp. 311-313, 4 figs. Formula for safe working pressure; maximum ultimate tensile strength for steel; factors of safety. (To be continued.)

Exhaust Steam

Commercial Value of Exhaust Steam, Frederick C. Ruck. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 498-507. Data from actual observations and practical experience covering a period of several years. Paper before Nat. Assn. of Stationary Engrs.

Turbine Gives Additional Line Shaft Power. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 430-432, 1 fig. Possibilities for expansion by use of exhaust steam in low-pressure turbines; efficiency of reduction gears.

Straight-Flow Engines

Details of Construction of Straight-Flow Steam Engines (Constructie-details van gelykstroom-stoommachines), D. A. De Fremery. De Ingenieur, year 33, no. 42, Oct. 19, 1918, pp. 807-817, 23 figs.

Turbines

Avoiding Distortion in Turbine Operation, Webster Tallmadge. Power, vol. 48, no. 22, Nov. 26, 1918, pp. 762-765, 8 figs. Explaining some of careless treatments afforded steam turbines through ignorance and thoughtlessness and how to avoid them.

Care in the Operation of Small Turbines, J. A. MacMurchy. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 744-745. Parts of small steam turbine which should receive particular attention.

The Steam Turbine (IX). Southern Engr., vol. 30, no. 4, Dec. 1918, pp. 52-53, 3 figs. Installation, operation and maintenance of Terry steam turbine. (To be continued.)

See also MECHANICAL ENGINEERING, Lubrication (Steam Cylinders), Motor-Car Engineering (Steam Vehicles).

THERMODYNAMICS

Heat-Transmission Tables

New Heat Transmission Tables (II), William R. Jones. Heat. & Vent. Mag., vol. 15, no. 11, Nov. 1918, pp. 24-29. Compilation of factors as given by leading authorities covering latest types of construction.

Specific Heats

The General Character of Specific Heats at High Temperatures, Walter P. White. Proc. Nat. Academy of Sci., vol. 4, no. 11, Nov. 1918, pp. 343-346. Experimental determination of specific heats of three forms of silica and two silicates for temperatures up to 1300.

WELDING

Electric Welding

A New Type of Portable Arc Welder. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, p. 64, 2 figs. Arrangement consisting of Lincoln 150-ampere arc-welding generator direct-connected to Wington G. L. 5 gasoline engine and intended for mounting on automobile truck.

Boiler and Other Repairs by Electric Welding. Can. Machy., vol. 20, no. 21, Nov. 21, 1918, pp. 596-599, 4 figs. Development of art and conditions necessary to insure satisfactory results. Paper before Inst. of Marine Engrs.

Electric Arc Welding, Robert E. Kinkead. Power, vol. 48, no. 22, Nov. 26, 1918, pp. 791-792. General descriptive article. Paper before Cleveland Eng. Soc.

Electric Welding—A New Industry, H. A. Horner. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 10, Oct. 1918, pp. 1185-1195, 29 figs. Brief review of uses of electric spot and arc welding in the United States prior to formation of Electric Welding Committee of Emergency Fleet Corporation; developments in apparatus in last six months; activities of Welding Committee in applying electric welding process to shipbuilding industry.

Electric Welding for Shipbuilding Purposes, W. S. Abell. Shipbuilding & Shipping Rec., vol. 12, no. 20, Nov. 14, 1918, pp. 471-474. Summary of investigations undertaken and of development of industry. Paper before North-East Coast Instn. Engrs. & Shipbuilders.

Electric Welding for Ships. Times Eng. Supp., no. 529, Nov. 1918, p. 239. Results of tests in regard to strength, elasticity, alternating stress and other factors affecting reliability of welded joints.

Electric Welding Nomenclature and Symbols. Ry. Rev., vol. 63, no. 20, Nov. 16, 1918, pp. 702-707, 34 figs. Scheme developed for Emergency Fleet Corporation to indicate types of welds in ship construction.

Electric Welding on the Rock Island Lines, E. Wanamaker. Boiler Maker, vol. 18, no. 11, Nov. 1918, pp. 308-310. Gives actual results which show reduction in maintenance cost. Before Western Ry. Club.

Inspection of Steel Arc Welds, O. S. Escholtz. Iron Age, vol. 102, no. 23, Dec. 5, 1918, pp. 1390-1391, 2 figs. Factors determining their character; penetration and electrical tests; analysis of welds and their heat treatment.

Nomenclature for Electric Welding, H. G. Knox. Engineering, vol. 106, no. 2758, Nov. 8, 1918, pp. 522-526, 27 figs. From paper before Engrs.' Club of Philadelphia, June 26, 1918.

The Welding of Steel, B. K. Smith. Am. Mach., vol. 49, no. 23, Dec. 5, 1918, pp. 1025-1026. From paper before Northwestern Welders' Assn., Minneapolis, Oct. 1918.

Heat Treatment

Treatment of Metals After Welding. Can. Mfr., vol. 38, no. 8, Aug. 1918, pp. 29-30. Practical guide as to correct temperature to which metal should be heated and order of procedure. Prepared by l'Air Liquide Society, Toronto.

Oxyacetylene Welding

Defective Oxy-Acetylene Welds, D. Richardson. Flight, vol. 10, no. 42, Oct. 17, 1918, pp. 1175-1176. Brief considerations on six causes of defective welds: impure acetylene, irregular delivery of gases, faulty manipulation of blowpipe, faulty filling materials, faulty preparation and adjustment, and faulty after-treatment of welds. Paper before British Acetylene Assn.

Oxy-Acetylene Pipe Welding and Cutting. Gas Age, vol. 42, no. 11, Dec. 2, 1918, pp. 471-474, 7 figs. Résumé of standard practice. (To be continued.)

The Oxy-Acetylene Flame and Blowpipe Efficiency, Arthur Stephenson. Acetylene & Welding Jl., vol. 15, no. 181, Oct. 1918, pp. 174-179, 2 figs. Volumes of air, oxygen and nitrogen required in flame; factor governing heating value per unit volume consumed; conditions which limit temperature of flame. (To be continued.)

The Steel Ship and Oxy-Acetylene Welding, J. F. Springer. Inst. Mar. Eng., vol. 23, no. 12, Dec. 1918, pp. 699-701. Behavior of steel when heated. Restorative measures.

VARIA

Alignment Charts

Construction of Alinement Charts, Ralph E. Turner. Power Plant Eng., vol. 22, no. 23, Dec. 1, 1918, pp. 956-961, 7 figs. Working formulæ of three variables into simple alinement charts.

China

China a Market for the American Machine

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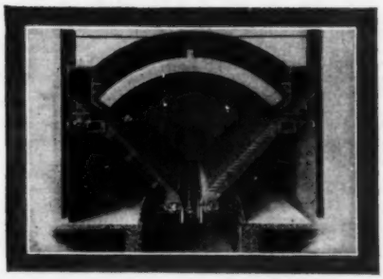

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Tool, L. W. Schmidt. Am. Mach., vol. 49, no. 20, Nov. 14, 1918, pp. 893-896. Electric power and industrial development; possibilities for American trade; difficulties to overcome.

Engineers' Act on Status of

Draft of Proposed Act for Engineers. Jl. Eng. Inst. Can., vol. 1, no. 7, Nov. 1918, pp. 331-332. Wording of Act proposed in province of Saskatchewan defining the status of the engineer.

Handles

The Uses of Wood (VII), Hu Maxwell. Am. Forestry, vol. 24, no. 299, Nov. 1918, pp. 679-687, 15 figs. Woods used in manufacture of handles.

Logging

Filling the Allies' Rush Order for Airplane Spruce, Nathan A. Bowers. Eng. News-Rec., vol. 81, no. 23, Dec. 5, 1918, pp. 1023-1031, 11 figs. Best talent of country assembled to develop methods new to logging and sawmill practice; 13 railroads built and 100,000 workers coördinated.

Pliers

Manufacturing Drop-Forged Pliers, Ellsworth Sheldon. Am. Mach., vol. 49, no. 20, Nov. 14 1918, pp. 889-893, 14 figs. Describing operations involved in manufacture of drop-forged pliers.

Electrical Engineering

ELECTROCHEMISTRY

Electrolytes

The Abnormality of Strong Electrolytes. II. The Electrical Conductivity of Non-Aqueous Solutions, Jnanendra Chandra Ghosh. Jl. Chem. Soc., vols. 113 and 114, no. 670, Aug. 1918, pp. 627-638. Application to non-aqueous solutions of author's equation derived from modification of Maxwell's equation of distribution of velocities.

Reduction of Metals

Electric-Furnace Reduction of Certain Metals Susceptible of Industrial Utilization (Sur la preparation au four électrique de quelques métaux susceptibles d'utilisation industrielle), Jean Escard. Revue Générale de l'Electricité, vol. 4, no. 11, Sept. 14, 1918, pp. 375-386, 3 figs. Notes on reduction of barium, calcium, glucinum, cobalt, nickel, titanium, manganese, chromium, molybdenum, tungsten, vanadium.

ELECTROPHYSICS

Distribution, Electrostatic

The Electron Theory of Metallic Conductors Applied to Electrostatic Distribution Problems, L. Silberstein. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 215, Nov. 1918, pp. 413-420. General expression for equilibrium distribution in terms of total charge and potential of external field, and application of general formula to cases of full spherical conductors and hollow sphere.

Electrospherical Functions

Electrospherical Functions Expressed as Determinants (Les fonctions électrosphériques sous forme de déterminants), Pierre Humbert. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 12, Sept. 16, 1918, pp. 428-430. Expresses three electrospherical polynomials in terms of determinants of order p for the first two and the order $p+1$, for the last. Also in Revue Générale de l'Electricité, vol. 4, no. 18, Nov. 2, 1918, pp. 651-652; Annales de Physique, vol. 9, series 9, 1918.

Periodic Currents

Oscillating Energy (Energie oscillante), G. Szarvady. Revue Générale de l'Electricité, vol. 4, no. 12, Sept. 21, 1918, pp. 411-422, 2 figs. Application of Ohm's law and Kirchhoff's laws to watt currents and wattless components of electromotive forces and intensities of periodic currents.

Saturation

On the Calculation of Magnetic and Electric Saturation Values, J. R. Ashworth. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 351-360. Deduces $I_0 = \sqrt{(R/R^1)}$ where I_0 is limiting intensity of magnetization, R the gas constant and R^1 the reciprocal of the product of susceptibility into absolute temperature; also ($i_0 = \sqrt{(R/S)}$, where i_0 is maximum current density a conductor can carry, S ratio of resistivity to absolute temperature and V the velocity of electron as it passes along conductor.

Vacuum Phenomena

Rectification by Vacuum Discharge (in Japanese), T. Kujirai. Denki Gakkwai Zasshi, no. 361, Aug. 31, 1918.

Theory of Coolidge Tube (Sur la théorie du fonctionnement du tube Coolidge à radiateur), A. Dauvillier, Revue Générale de l'Electricité, vol. 4, no. 13, Sept. 28, 1918, pp. 443-445. Explains increase in resistance by presence of large quantity of oxygen liberated at focus and by partial oxidation of filament, together with formation of double layer which diminishes electronic emission.

Vibration, Mechanical, Generating Electrical Energy

Experiments on the Effect of the Vibration of a Stretched Wire Forming Part of a Closed Electric Circuit, Henry Jackson. Proc. Roy. Soc., vol. 95, no. A665, Sept. 2, 1918, pp. 51-57. Experiments with sensitive telephone detector which in author's judgment confirm Marran's suggestion that a mechanical vibration or note produces electricity.

GENERATING STATIONS

Alternators in Parallel

Synchronizing Alternators Coupled in Parallel (La mise en phase dans le couplage en parallèle des alternateurs), Elivind Styff. Revue Générale de l'Electricité, vol. 4, no. 13, Sept. 28, 1918, pp. 460-465, 11 figs. Schemes of connections and diagrams of electromotive forces. From Elektrotechnische Zeitschrift, vol. 38, Sept. 20, 1917, p. 461.

Turbo-Alternators

Accidents to Steam Turbo-Alternators (Au sujet des accidents aux turbo-alternateurs à vapeur), P. Boucherot. Revue Générale de l'Electricité, vol. 4, no. 13, Sept. 28, 1918, pp. 457-460. Report of Sub-Committee of Union of Electrical Syndicates proposing as a result of studies (1) modifications in present designs of turbo-alternators, (2) modifications in usual specifications, and (3) dispositions to reduce loss when accident occurs.

The Production of Electricity by Steam Power, Alex. Dow. Elecn., vol. 81, no. 2111, Nov. 1, 1918, pp. 555-557. Abstract of address before Am. Electrochemical Soc.

GENERATORS AND MOTORS

Direct-Current Motors

Weight of Direct-Current Motors, A. Brunt. Elec. Eng., vol. 52, no. 2, Aug. 1918, pp. 28-29, 2 figs. Requirements of direct-current motors and graphs showing relation between weight and torque for commutating-pole and non-commutating-pole motors, and also between weight and torque for various makes of apparatus.

Induction Motors

Changing Speed of Induction Motors. Power Plant Eng., vol. 22, no. 22, Nov. 15, 1918, pp. 926-928, 2 figs. Possible speed changes of induction motors to suit conditions in power plants.

Rolling-Mill Motors

Standardizing Large Rolling Mill Motors, K. Pauly. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 411-414, 1 fig. Suggests motors be rated on continuous capacity at some particular temperature in order to avoid present difficulties of users of large rolling-mill motors. Paper before Assn. Iron & Steel Elec. Engrs.

Single-Phase Generators

Armature Reaction and Wave Form of a Single-Phase Generator (in Japanese), G. Shimizu. Denki Gakkwai Zasshi, no. 362, Sept. 10, 1918.

Starting Resistances

Method for Determining Resistance Used for Starting Various Types of Motors, B. W. Jones. Power, vol. 48, no. 21, Nov. 19, 1918, pp. 740-744, 6 figs. A simple method for determining the ohmic value of resistance used for starting series-, shunt- and compound-wound direct-current motors and wound-rotor induction motors under various load conditions.

Synchronous Motors

For and Against Synchronous Motors, Will Brown. Elec. World, vol. 72, no. 21, Nov. 23, 1918, pp. 982-984, 4 figs. Four objections that have been frequently made to using synchronous motors; discussion showing how conditions have changed; synchronous motors and unity power factors.

Temperature Rise

Guarantees for Temperature Rise in Electrical Machinery, with Special Reference to Large Turbo-Generators, A. E. Du Pasquier. Tran. South African Inst. Elec. Engrs., vol. 9, part 7, July 1918, pp. 127-137 and (discussion) pp. 137-140. Urges that there is no good reason for restricting temperature rises, providing suitable materials are obtainable for withstanding the heat conditions that may arise.

See also MECHANICAL ENGINEERING, Fuels and Firing (Load Factor), Power Plants (Central Stations).

LIGHTING AND LAMP MANUFACTURE

Arc-Lamp Globes

Renovation of Discolored Arc-Lamp Globes, Alfred Herz. Elec. World, vol. 72, no. 20, Nov. 16, 1918, pp. 935-936, 2 figs. Description of a system of removing stain by heat treatment.

MEASUREMENTS AND TESTS

Galvanometers

The Einthoven Galvanometer, Samuel D. Cohen. Wireless World, vol. 6, no. 68, Nov. 1918, pp. 437-438. Special simple construction of Einthoven type used by writer for measuring radio receiving currents. From Elec. Experimenter.

Insulation Measurement

Electrolytic Method of Measuring Electrostatic Field of Insulators (La mesure du champ électrostatic dans les isolateurs, d'après la méthode électrolytique), W. Estorff. Revue Générale de l'Electricité, vol. 4, no. 12, Sept. 21, 1918, pp. 433-434, 1 fig. A small line is placed between electrodes in electrolyte and ratio of resistances of distances between line and each electrode is determined by Wheatstone bridge operating circuit with alternating current; correction coefficient for air values is determined in similar manner. From Elektrotechnische Zeitschrift, vol. 39, Feb. 7, 14 and 21, pp. 53, 62 and 76, 28 figs.

Some Notes on Leakage Indicators, G. W. Stubbings. Electricity, vol. 32, no. 1451, Aug. 30, 1918, pp. 453-454, 1 fig. Principle of instruments measuring state of insulation of a complete electrical system.

Meters

The Demand-Meter Situation, C. F. Mathes. Elec. World, vol. 72, no. 22, Nov. 30, 1918, pp. 1024-1026. Critical discussion of demand meters, pointing the advantages that are gained through use of well-known types of these instruments and remedies for some of the troubles encountered in their practical application.

Official Testing Laboratories

British Electrical Proving House. Times Eng. Supp., no. 527, Sept. 1918, p. 197. Essentials of schemed testing institution, with authoritative credentials, to deal with types of apparatus rather than with individual specimens.

Test-Ring Method

Test Ring Method for Determining Transformer Ratio and Phase Error, H. S. Baker. Elec. Rev., vol. 73, no. 20, Nov. 16, 1918, pp. 766-769, 6 figs. Use of special watt meter and current transformer for current transformer testing. From paper before Am. Inst. of Elec. Engrs.

POWER APPLICATIONS

Cement Industry

Electric Motors in the Cement Industry, R. B. Williamson. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 11, Nov. 1918, pp. 1237-1273, 9 figs. Outline of various kinds of machinery used, and data as to power requirements; description of types of motor best suited to each application together with starting characteristics, overload capacity, torque and other features. Also in Elec. Rev., vol. 73, nos. 20 and 21, Nov. 23 and 26, 1918, pp. 770-771 and 813-814.

Coal Mining

Explosionproof Equipments of Colliery Motors and Accessories (in Japanese). Denki Gakkwai Zasshi, no. 363, Oct. 10, 1918.

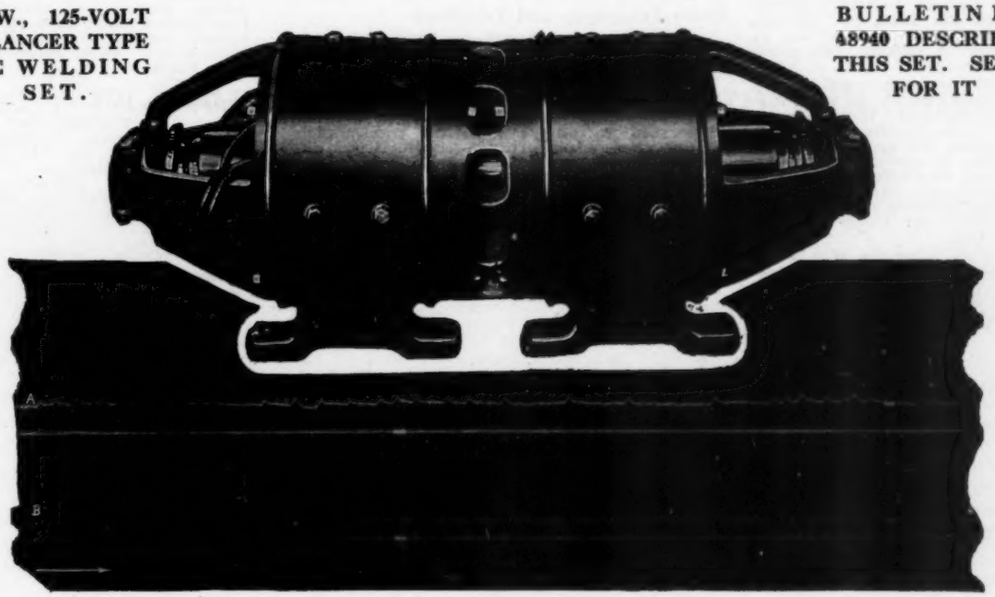
The Use of Electric Power in the Mining of Anthracite Coal, J. B. Crane. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 10, Oct. 1918, pp. 1197-1202, 7 figs. Power cost and current consumption of anthracite mines, also of bituminous mines; estimates of additional coal obtainable by electrification of anthracite mines, illustrations showing representative installations of electric drive.

Furnaces

Notes on Electric-Furnace Problems, J. L.

3-KW., 125-VOLT BALANCER TYPE ARC WELDING SET.

BULLETIN NO. 48940 DESCRIBES THIS SET. SEND FOR IT



Oscillograph curve, showing electrical conditions in welding circuit of constant energy arc welding equipment. Curve "A" shows current in arc, approximate average value 150 amps. Curve "B" shows voltage across arc, approximate average value 15½ volts.

Steady flow of metal assured by efficient and simple G-E Welders

G-E constant energy arc welding sets are used to assure a steady flow of metal into the weld and high operating efficiency.

A constant flow of metal is assured by the inherent automatic regulation of the energy in the welding circuit throughout the welding range for metal electrodes.

The distribution of welding current between the two units comprising the set and practically dispensing with external resistance in series with arc, assures high efficiency.

One small panel and the set illustrated are all the equipment needed for a one-man outfit where operator has mask and electrode with flexible cable—if 125-volt direct current is available.

Consistently perfect welds are being produced in many industries by the use of this equipment.

We are prepared to demonstrate these sets and make good deliveries

43-88

General Electric Company

General Office Schenectady, N. Y

McK. Yardley. Bul. Am. Inst. Min. Engrs., no. 142, Oct. 1918, pp. 1593-1598, 4 figs. Analysis made to determine maximum capacity and aproximate performance of a new furnace designed to operate at 160 volts on a 60-cycle current.

Power Factor of the Electric-Arc Furnace (Fattore di potenza dei forni elettrici ad arco), O. Scarpa. Revista Tecnica d'Elettricita, no. 1891, Oct. 25, 1918, pp. 105-106. Presents formula for power factor of arc including power factor of furnace and ohmic resistance of electrodes.

Technical Analysis of Industrial Electric Furnaces: Classification, Choice of Apparatus, Installation and Operation (Considération techniques sur les fours électriques industriels; classification, choix des appareils, installation, mode d'emploi et conduite) Jean Escard. Revue Générale de l'Electricité, vol. 4, no. 16, Oct. 19, 1918, pp. 575-591, 31 figs. Electric arc furnaces; electric resistance furnaces; induction furnaces; electrothermotic and aluminum furnaces.

The Electric Furnace After the War, Francis A. J. Fitzgerald. Elec. Rev., vol. 73, no. 19, Nov. 9, 1918, pp. 726-727, 2 figs. Effect of the war upon electric furnaces; new uses to replace war's needs; tendencies in furnace design.

Heating

Electric Heat for Drying and Baking, George J. Kirkgasser. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 489-495, 11 figs. Types of industrial aparatus that have had rapid development during past five years.

Electric Thermal Storage Heaters for Rooms, English Mechanic & World of Sci., vol. 108, no. 2796, Oct. 25, 1918, pp. 155-156. Summary of report used by Committee of Swiss Electrotechnical Union. From Schweizerischer Elektrotechnischer Verein, Bul. June 1918.

Electrically Heated Industrial Appliances and Devices, George J. Kirkgasser. Indus. Management, vol. 56, no. 5, Nov. 1918, pp. 417-423, 32 figs. Outlines most important applications classified for 18 different industries, and shows many of simpler devices.

Iron-Ore Mining

Central Station Service Used in Operation of New Jersey Iron Ore Mines, L. R. W. Allison. Elec. Rec., vol. 24, no. 4, Oct. 1918, pp. 24-26, 5 figs. Installation where energy generated at steam station is transmitted to mines at 33,000 volts for operation of pumps, air compressors, hoists, etc., involving consumption of 600,000 kw-hr. per month.

Lime Plant

A Modern Motor-Driven Lime Plant. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 19-20, 4 figs. Processes in electrically-driven plant utilizing waste marble.

Pumping

Electricity Supersedes Steam in Los Angeles. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 18-19, 3 figs. Electrical operation of pumping plants, it is said, will effect an annual saving of 18,000 bbl. of fuel oil. Also in Elec. Rev., vol. 73, no. 19, Nov. 9, 1918, pp. 723-725, 3 figs.

High Efficiencies Shown by Motor-Driven Water Works Pumps, Geo. H. Gibson. Can. Engr., vol. 35, no. 19, Nov. 7, 1918, pp. 412-413, 2 figs. Data on two 12-in. centrifugal pumps.

Rolling Mills

Electrically Driven Mills at Bethlehem, J. T. Sturtevant. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 417-419, 10 figs. Layout, equipment, power consumption and tonnage on eleven installations at Lehigh plant, where G. E. induction motors are used.

Ship Propulsion

Electricity's Part in Building and Navigating of Ships, H. A. Hornor. Elec. Eng., vol. 52, no. 2, Aug. 1918, pp. 15-22, 20 figs. Considerations entering into selection of propulsion: commercial angle, first cost, efficiency, safety, upkeep, cost of operation, etc.; propelling machinery of various ships. (Concluded.)

Silk Industry

Electric Drive Applied to Silk Industry, Charles T. Guilford. Elec. Rev., vol. 73, no. 22, Nov. 30, 1918, pp. 855-857, 4 figs. Advantages of central-station service for this work; selection of motors and drives; interesting data on present installations.

Sugar Mills

Complete Electrification of Sugar Mills, Clarence G. Hadley. Elec. World, vol. 72, no. 22, Nov. 30, 1918, pp. 1022-1024, 2 figs. Extensive application of motors in this industry of recent origin; satisfactory results obtained in new Cuban mills, showing possibilities that may arise in this field as it is developed.

See also CIVIL ENGINEERING, Earthwork, Rock Excavation, etc.; MECHANICAL ENGINEERING, Hoisting and Conveying (Electric Hoisting Machines), Welding (Electric Welding); METALLURGY, Alloys, Ferrous.

TELEGRAPHY AND TELEPHONY

Radio Telegraphy and Telephony

A Combination Circuit for Tube and Crystal. Wireless Age, vol. 6, no. 2, Nov. 1918, p. 21, 1 fig. Combined or individual use of vacuum tube and crystal rectifier.

A New Protective Condenser. Wireless Age, vol. 6, no. 2, Nov. 1918, p. 34, 1 fig. Designed to protect electrical transmission lines from effect of high-frequency disturbances.

A Novel Radio Telegraph Aerial. Wireless Age, vol. 6, no. 2, Nov. 1918, p. 20, 1 fig. Type having series of coils inserted in antenna from earth to free end.

A Thermionic Valve Slopemeter, E. V. Appleton. Wireless World, vol. 6, no. 68, Nov. 1918, pp. 458-460, 3 figs. Derives formula to compute slopes of grid voltage-anode current and plate voltage-anode current curves at any particular operating plant.

Marconi's Improved Radio Transmitter. Wireless Age, vol. 6, no. 2, Nov. 1918, pp. 19-20, 3 figs. Method of producing continuous oscillations by overlapping wave trains.

Method for Exhausting Vacuum Tubes. Wireless Age, vol. 6, no. 2, Nov. 1918, pp. 20-21, 1 fig. Apparatus which provides for heating anode by vigorous bombardment of electrons without endangering filament, this being method to drive gases from plate.

Propagation of Electric Currents in an Antenna (Propagation des courants électriques dans une antenne), H. Chireix. Revue Générale de l'Electricité, vol. 4, no. 11, Sept. 14, 1918, pp. 363-374, 9 figs. Formulae (1) in general case of non-homogenous antennae, (2) when antenna consists of one branch, (3) when it consists of two, and (4) when it consists of three branches having different self-inductances and different capacities.

Solid-Contact Detectors (Contribution à l'étude des détecteurs à contacts solides). René Audubert. Journal de Physique, vol. 7, May-June 1918, pp. 127-128. Study of physical phenomena which probably take place in the action of crystal detectors used in wireless telegraphy. (To be continued.)

Some Aspects of Radio Telephony in Japan, Eitaro Yokoyama. Wireless World, vol. 6, no. 68, Nov. 1918, pp. 430-435, 8 figs. Account of recent discoveries; evolution of a rarefied gas discharger. (To be continued.)

The Radioelectric Installation at Stavanger, Norway (Stavanger Radio), Olaf Moe. Teknisk Ukeblad, year 65, no. 43, Oct. 25, 1918, pp. 505-514, 23 figs. (To be continued.)

Telephony (Wire)

How to Locate Telephone Troubles. J. Bernard Hecht. Telephony, vol. 75, nos. 21, 22 and 23, Nov. 23, 30 and Dec. 7, 1918, pp. 32-34, 3 figs.; 13-16, 10 figs, and 16-18, 2 figs. Rural line telephones and their circuits. Suggestions to managers, wire chiefs and troublemen of local battery exchanges. (Continuation of serial.)

Wave-Length and Weakening of Telephone Circuits (Longueur d'onde et affaiblissement des circuits téléphoniques), Pomey. Revue Générale de l'Electricité, vol. 4, no. 8, Aug. 24, 1918, pp. 251-253. Simplification of author's formula for constant *B* given in Aug. 3 issue.

TRANSFORMERS, CONVERTERS, FREQUENCY CHANGERS

Transformers, A. C.

Study of the Calculations Involved in the Design of Large Capacity Transformers for Use with Electric Furnaces (Etude sur le calcul de transformateurs à forte intensité pour fours électriques), R. Jacquot. Revue Générale de l'Electricité, vol. 4, no. 15, Oct. 12, 1918, pp. 523-536, 9 figs. Explains sudden variations in efficiency and voltage drop by conditions of varying load and suggests practical and economical modifications. (To be continued.)

Rectifiers

Three-Phased Current Rectifier (Convertitore di correnti trifasi in correnti continue), O. M. Corbino. L'Elettrotecnica, vol. 5, no. 28, Oct. 5, 1918, pp. 392-394, 3 figs. Apparatus operating by rotary mercury jet.

Substations

Electric Railway Substations for Automatic Transformation (Sottostazioni di trasformazione automatiche per l'alimentazione de ferrovie elettriche), A. Gusmano. L'Elettrotecnica, vol. 5, no. 31, Nov. 5, 1918, pp. 444-446, 6 figs. Principles of system followed in America.

Permanence in Outdoor Substations, S. B. Hood. Elec. World, vol. 72, no. 20, Nov. 19, 1918, pp. 928-930, 6 figs. Discussion of standard design used in all sizes from 300 kva. to 2250 kva. in order to eliminate fire losses prevalent in modern structures; increase in cost to secure permanence held to be negligible.

Remote Controlled Substations Described, W. T. Snyder. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 408-410, 2 figs. Control for central station and motor-generator substation located about 2200 ft. from main power station, feeding 250-volt direct-current transmission line. Paper before Assn. Iron & Steel Elec. Engrs.

Transformers, D. C.

Size and Working Cost of Machines for Continuous-Current Transformation, Thomas Carter. Elecn., vol. 81, no. 2108, Oct. 11, 1918, 4 figs. Methods of continuous-current transformation; differences between three schemes; conclusions in regard to cost and method of operation; curves of overall efficiency of transformer; schemes for variable-speed motors.

Frequency Changer

Radio Frequency Changers, E. E. Bucher. Wireless Age, vol. 6, no. 2, Nov. 1918, pp. 10-13, 8 figs. Reported progress in their application to wireless telegraphic and telephonic communication. (To be continued.)

TRANSMISSION, DISTRIBUTION, CONTROL

Distribution, Three-Phase

Economic Increase Made in Distribution Capacity, S. Bingham Hood. Elec. World, vol. 72, no. 22, Nov. 30, 1918, pp. 1030-1032, 7 figs. Saving of copper and transformers by replacing old overloaded 2300-volt system with 2300-2400-volt star-connected, three-phase, common-neutral primary and interconnected secondary.

How to Remedy Inconveniences of Excessive Overload in Three-Phase Network (Comment peut-on remédier aux inconvénients d'une très forte surcharge dans un réseau triphasé), E. Piernet. Revue Générale de l'Electricité, vol. 4, no. 15, Oct. 12, 1918, pp. 540-544, 2 figs. Proposes adjustment of step-up and step-down transformers so as to be able to dispose of voltage U so long as delivered power does not exceed a certain limit and of voltage $U\sqrt{3}$ when delivered power exceeds this limit.

Interconnection

More Light on New England Interconnection. Elec. World, vol. 72, no. 22, Nov. 30, 1918, pp. 1027-1029, 1 fig. Estimated savings to be exceeded; convenient energy-exchange arrangements; railroad electrification possible without buying new generators; price at which tie-line energy can be sold. From paper by L. L. Elden before Boston Section of Am. Inst. of Elec. Engrs.

Relays

Factors to Consider in Applying Relays, E. A. Hester, Elec. World, vol. 72, no. 20, Nov. 16, 1918, pp. 931-934, 9 figs. Determination of short-circuit current connections and settings suitable for radial and parallel feeder systems; protection against high-resistance grounds on balance systems.

Relay Protective Devices, C. J. Monk. Tran. South African Inst. Elec. Engrs., vol. 9, part 7, July 1918, pp. 140-143, 1 fig. Proposes short method of obtaining approximate circuit currents by observing voltage drop between two stations at normal load, according to equation: short-circuit current = normal voltage times load current divided by voltage drop. Discussion of paper published in Jl. of Inst., Oct. 1917.

Switches

An Automatic Three-Phase Switch, W. Ernst. Elecn., vol. 81, no. 2108, Oct. 11, 1918, pp. 491, 4 figs. Abstract of article in Elektrotechnische Zeitschrift, No. 4, 1918.

Safety Features in Switching Installations, M. M. Samuels and F. Bechoff. Elec. World, vol. 72, no. 19, Nov. 9, 1918, pp. 878-880, 9 figs. Review of existing alarm systems used to indicate switch positions and overheating of apparatus; weak points in installations and suggestions designed to bring about their improvement.

Transmission Lines

Locating Troubles in Electric Lines (Note sur les essais et mesures relatifs aux lignes électriques), Louis Puget. Revue Générale de l'Electricité, vol. 4, no. 16, Oct. 19, 1918, pp. 563-565, 2 figs. Method for measuring resistance of line and locating a ground, which author claims to have found serviceable in his experience with underground lines. The methods given are applicable to overhead lines as well.

110,000-Volt Transmission Line over the St. Lawrence River, S. Svenningson. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 11, Nov.

I. P. Morris Hydraulic Turbines

The Wm. Cramp & Sons Ship & Engine Building Co.

Richmond and Norris Sts., Philadelphia

THE MOST POWERFUL TURBINE EVER BUILT

Cast iron volute casing of **37,500 H. P.** Turbine for The Niagara Falls Power Company. The turbine is designed to develop the above power under a head of 214 feet, at a speed of 150 R. P. M. We have two of these units now under construction in our shops.

1918, pp. 1275-1284, 3 figs. Account of investigation leading to construction of 350-ft. towers to support transmission wires on a span of 4800 ft.; design of towers and insulators; provisions for protection from ice and method of sag calculations.

WIRING

House Wiring

Three- and Four-Way Switch Circuits, Terrell Croft. Elec. Eng., vol. 52, no. 2, Aug. 1918, pp. 23-25, 5 figs. Cottage wiring; unusual wiring; two-location control. (Concluded.)

Civil Engineering

BRIDGES

Concrete Bridges

Bridging the James River at Richmond, Va. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 15-16. General dimensions of structure consisting of 18 reinforced-concrete arch spans.

Reinforced Concrete Bridges and Their Architectural Treatment, F. G. Engholm. Contract Rec., vol. 32, no. 45, Nov. 6, 1918, pp. 880-883, 6 figs. Recommends considerations of fitness, proportion and adaptability in design, and moderate use of decorations.

Reinforced-Concrete Trestles. Sci. Am. Supp., vol. 86, no. 2238, Nov. 23, 1918, p. 324, 3 figs. Viaducts recently constructed by Can. Pac. Ry.

Design

New Impact Formulæ Needed in Designing Bridges of Various Types, J. A. L. Waddell. Eng. News-Rec., vol. 81, no. 21, Nov. 21, 1918, pp. 924-928, 2 figs. Scarcity of experimental knowledge of impact shown by review of tests and studies; group of formulæ proposed; lower impact allowances for solid-floor bridges and concrete arches.

The Principal Bridges of the World. Sci. Am. Supp., vol. 86, nos. 2235 and 2236, Nov. 2 and 9, 1918, pp. 286-288 and 294. Comparison of their size, importance and principles of design.

Highway Bridges

Standardization of Detail in Highway Bridge Design, M. W. Torkelson. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 33-34. Practice of Wisconsin Highway Commission.

Lift Bridges

Scherzer Lift-Bridge at Keadby (Ponte levatolo tipo Scherzer a Keadby). Ingegneria Italiana, vol. 2, no. 37, Sept. 5, 1918, pp. 131-134, 7 figs. Plans, dimensions and details of mechanism. From Génie Civil, Jan. 19, 1918.

Railroad Bridges

Special Foundation Work for a Railroad Bridge, J. H Merriam. Ry. Age, vol. 65, no. 22, Nov. 29, 1918, pp. 951-953, 6 figs. New Burlington structure over Platte River is supported entirely on concrete piles.

Wilson Bridge

The Wilson Bridge at Lyons. Engineer, vol. 126, no. 3280, Nov. 8, 1918, pp. 387-388, 9 figs. Drawings, illustrations and description of le pont Wilson, formally opened at Lyons July 14, 1918, and named in honor of President Wilson.

BUILDING AND CONSTRUCTION

Churches

Steel Construction Characterizes Chicago Church. Eng. News.-Rec., vol. 81, no. 19, Nov. 7, 1918, pp. 860-863, 5 figs. Cantilever trusses carry front wall and gallery; dome trusses are supported by girders on tall four-post tower having no interior bracing.

Concrete Pedestal Pile

The McArthur Concrete Pedestal Pile. Contract Rec., vol. 32, no. 42, Oct. 16, 1918, pp. 830-831, 2 figs. Process followed in construction of pile consisting of a 16-in. cylindrical shaft, with an enlarged base.

Fire-Resistive Construction

Fire Resistive Construction Committee Report. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 13-14, 1 fig. Specifications drawn by joint conference of representatives from ten American technical societies and the Can. Soc. of Civil Engrs.

Railroad Station

Toronto's Union Station Nears Completion. Contract Rec., vol. 32, no. 41, Oct. 9, 1918, pp. 805-808, 9 figs. Waterproofing; roof; elevators.

Reservoirs, Oil

Circular Earth Embankment Lined with Concrete Forms Oil Reservoir, E. D. Cole. Eng. News-Rec., vol. 81, no. 21, Nov. 21, 1918, pp. 932-936, 3 figs. Type originated in California; introduced into Texas fields on account of lack of steel; concrete roof carried on wood frame also because of lack of steel.

Reinforced Concrete Fuel-Oil Tanks. Can. Engr., vol. 35, no. 17, Oct. 24, 1918, p. 376, 2 figs. Dimensions and process of executing work.

Reservoirs, Water

Newton, Mass., Water Reservoir, Edwin H. Rogers. Eng. Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 9-12, 3 figs. Details of its four rectangular sections and circular gate chamber at center, in which are installed a steel distributing tank and pipes from force main to different sections and overflow pipes and drains. From Proc. Boston Soc. Civil Engrs.

Reinforced Concrete Reservoirs, Montevideo. Engineering, vol. 106, no. 2756, Oct. 25, 1918, pp. 453-455, 43 figs. Description of two 6,500,000-gal. reservoirs constructed for City of Montevideo, Uruguay, R. C. Parsons, Engineer. Drawings of principal features.

Scaffolds and Falsework

Safe Construction of Scaffolds and Falsework, T. F. Foltz. Contract Rec., vol. 32, no. 42, Oct. 16, 1918, pp. 826-829. Outlines general construction of pole, suspended, outrigger, carpenters' bracket and painters' scaffolds, and indicates their general construction requirements. Paper before Nat. Safety Council.

Submerged Structures

Essentials of Proper Construction, J. W. Rollins. Contract Rec., vol. 32, no. 44, Oct. 30, 1918, pp. 870-873. Requirements of concrete for submerged structures.

See also ORGANIZATION AND MANAGEMENT, Lighting.

CEMENT AND CONCRETE

Agregate

Clean Aggregates Obtained under Difficult Conditions, C. P. Mowry. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 31-32, 3 figs. Arrangement and working of a western plant.

Proportioning the Materials of Mortars and Concretes by Surface Areas of Aggregates, L. N. Edwards. Surveyor, vol. 54, no. 1398, Nov. 1, 1918, pp. 209-210. Results of tests made by Toronto Department of Works with object of developing surface-area method of proportioning and securing information relative to (1) surface area of aggregates of varying granulometric composition, (2) quantity of water necessary to produce a "normal" uniform consistency of mortar for varying sands and cement constant, and (3) strength of mortar attained by varying proportion of cement in mix. Paper before Am. Soc. for Testing Materials.

Economical Production of Washed Sand and Gravel. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 52-54, 2 figs. Description of Gilbert screen.

Cement Gun

Cement Gun Used for Repairing Pit Stacks. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 399-401, 5 figs. Steel reinforcement placed on old shell and gunite applied.

Cold-Weather Concreting

Cold Weather Concreting. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 20-24, 8 figs. Effect of low temperatures on concrete work; suggestions of Portland Cement Assn. in regard to heating materials and protecting work.

Disintegration

Conclusions on Causes of Concrete Disintegration, A. Blackie. Eng. & Contracting, vol. 50, no. 21, Nov. 20, 1918, pp. 503-505. From paper before Eng. Ins. of Canada.

Form Units

One Set of Tool Forms Used Three Times Completes Concrete Foundry, J. M. Villadsen. Eng. News-Rec., vol. 81, no. 21, Nov. 21, 1918, pp. 950-951, 3 figs. Form units assembled on ground with reinforcement in place erected by derrick; concrete placed by telescoping chute.

Francois and Portier Cementation Processes

Cementation Processes of François and Portier, A. H. Krynauw. Contract Rec., vol. 52, no. 44, Oct. 30, 1918, pp. 864-865. Conditions most suitable for hard setting in shortest time when cement is pumped under pressure into fissures; cases in which cementation has been successfully applied; comparison between two processes. Paper before Chem. Metallurgical & Min. Soc.

Moisture

Effect of Water on Strength of Concrete. Contract Rec., vol. 52, no. 44, Oct. 30, 1918, p. 865, 1 fig. Diagram presenting amount of water used in per cent of quantity giving maximum strength against per cent of maximum strength. Drawn from results of experimental tests.

Saturation of Concrete Reduces Strength and Elasticity, M. B. Lagaard. Eng. News-Rec., vol. 81, no. 20, Nov. 14, 1918, pp. 908-910, 6 figs. Tests, made at University of Minnesota, show that moisture content of specimens serves to counteract benefits of moist curing.

See also CIVIL ENGINEERING, Building and Construction, Harbors.

EARTHWORK, ROCK, EXCAVATION, ETC.

Blasting

Drilling and Blasting in Construction of Halifax Ocean Terminals Railway. Eng. & Contracting, vol. 50, no. 21, Nov. 20, 1918, pp. 480-481. Description of some features of work. From paper by B. H. Smith before Eng. Inst. of Canada.

Quarry Blasting with Electricity, A. S. Anderson. Du Pont Magazine, vol. 9, no. 6, Dec. 1918, pp. 26-27, 3 figs. Ways of producing current and precaution to be observed.

Park Construction

Construction Plans Developed for the Bronx River Parkway Reservation, L. G. Holleran. Eng. News-Rec., vol. 81, no. 20, Nov. 14, 1918, pp. 899-903, 4 figs. Designs of Park Commission contemplate development of 1400 acres by grading and planting; numerous structures proposed; work to be done by day labor.

Quarrying

Quarry Economics, Oliver Bowles. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 49-50. Labor requirements of various drills; waste of labor through inefficient blasting; effect of physical character of rock.

HARBORS

Concrete Construction

The Use of Reinforced Concrete Construction in Harbor Work, A. F. Dyer. Jl. Eng. Inst. Can., vol. 1, no. 6, Oct. 1918, pp. 242-251, 11 figs. Descriptions derived from articles and papers published in technical journals and proceedings of technical societies. Also in Eng. & Contracting, vol. 50, no. 21, Nov. 20, 1918, pp. 483-485.

Piers

Compression Strengths of Large Brick Piers. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, p. 25. Summary of conclusions based on past records and recent investigation by Bureau of Standards, composed of tests on piers 2 ft. 6 in. sq. by 10 ft. high in which three grades of brick were used.

Ports

Railway Construction in Connection with the Halifax Ocean Terminals, R. H. Smith. Jl. Eng. Inst., Can., vol. 1, no. 6, Oct. 1918, pp. 281-288. Methods employed and difficulties overcome in construction operations which necessitated considerable excavation work and presented other difficulties.

St. John Harbor, Alex. Gray. Jl. Eng. Inst. Can., vol. 1, no. 6, Oct. 1918, pp. 273-278, 15 figs. Outstanding features in harbor and type of construction used in wharves.

The Port of Honduras. Times Eng. Supp., no. 527, Sept. 1918, p. 193. Projected improvements.

Sea Walls

Drive Inclined Precast Concrete Slabs for Sea Wall. Eng. News-Rec., vol. 81, no. 20, Nov. 14, 1918, pp. 897-898, 3 figs. Account of new type of beach protection replacing vertical concrete wall at Long Beach, Cal.

Pneumatic Caisson Method of Quay Wall Construction at Halifax. Eng. & Contracting, vol. 50, no. 21, Nov. 20, 1918, pp. 489-490, 2 figs. From paper by J. J. MacDonald before Eng. Inst. of Canada.

MATERIALS OF CONSTRUCTION

Timber

Decay in Mill-Roof Timber, R. J. Blair. Textile World Jl., vol. 54, no. 23, Dec. 7,

CRANE VALVES

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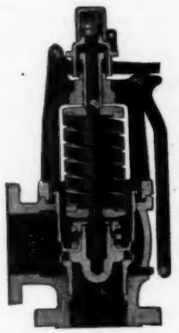

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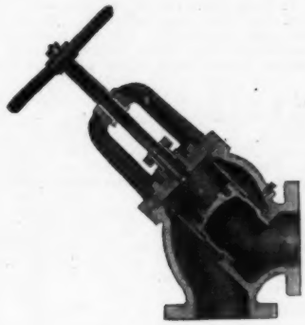

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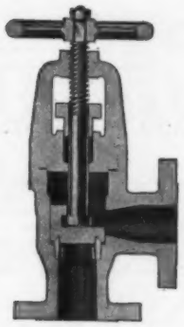

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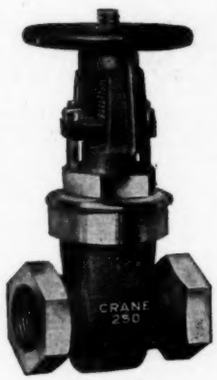

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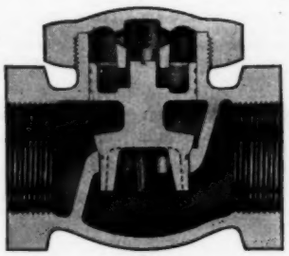

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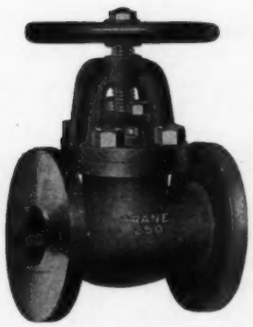

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1918, pp. 95-101, 4 figs. How it occurs and how it can be prevented. (To be continued.)

See also CIVIL ENGINEERING, Cement and Concrete.

MUNICIPAL ENGINEERING

Town Planning

The Problem of City Development, An Economic Survey, A. G. Dalzell. Jl. Eng. Inst. Can., vol. 1, no. 7, Nov. 1918, pp. 319-330, 16 figs. Comparison of rectangular and diagonal systems of city outline and study of conditions in Vancouver.

Town Planning in Halifax and Vicinity, H. L. Seymour. Jl. Eng. Inst. Can., vol. 1, no. 6, Oct. 1918, pp. 262-268, 3 figs. Schemes indicating width of streets, open spaces, building lines and character of buildings.

ROADS AND PAVEMENTS

Canada

Canadian Highway Construction, Harry Stewardson. Contract Rec., vol. 32, no. 46, Nov. 13, 1918, pp. 899-901. Considers how to distribute cost of construction and maintenance so that necessary money can be secured and necessary expense fairly placed upon people who use roads and communities which receive benefits.

Highway Work in Ontario. Good Roads, vol. 16, no. 20, Nov. 16, 1918, pp. 185-186 and 191. Progress made in Canadian Province.

Roadway Improvements in Ontario, W. A. MacLean. Contract Rec., vol. 32, no. 41, Oct. 9, 1918, pp. 813-819, 10 figs. Extracts from annual report of Department of Public Highways for 1917.

Concrete

Concrete Road Construction, William W. Cox. Good Roads, vol. 16, no. 18, Nov. 2, 1918, pp. 165-166 and 169, 1 fig. Precautions and care to be observed. Paper before Mich. State Good Roads Assn.

Vertical Movements in Concrete Pavements and a Suggestion Towards Their Elimination, J. W. Lowell. Eng. & Contracting, vol. 50, no. 19, Nov. 6, 1918, pp. 441-443, 4 figs. From paper before Am. Concrete Inst.

Cost Keeping

Better System of Highway Cost Keeping, J. J. Tobin and A. R. Losh. Contract Rec., vol. 32, nos. 44, 45 and 46, Oct. 30 and Nov. 6 and 13, 1918, pp. 866-869, 886-888 and 903-906, 4 figs. Study of principles governing cost keeping and application of these principles to highway work. Detail of cost accounts and necessary codes.

France

Principles Upon Which the French Highways Are Built, Frank W. Harris. Eng. News-Rec., vol. 81, no. 21, Nov. 21, 1918, pp. 935, 1 fig. Roman system of direct lines between strategic points followed; great attention is given to drainage.

Location

Putting the Right Road in the Right Place, Rodman Wiley. Am. City, vol. 19, no. 5, Nov. 1918, pp. 356-358, 4 figs. European practice in locating road; importance of exercising good judgment in grading and surfacing. Paper before Ky. Highway Engrs. Assn.

Macadam

Capacity of Macadam Roads for War Business Increased. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 990-992, 5 figs. Three-foot concrete shoulders added at each side without closing highways to traffic; war labor conserved by using convicts for construction.

Oiled Macadam Roads Resurfaced with Concrete, E. A. Burt. Eng. News-Rec., vol. 81, no 21, Nov. 21, 1918, pp. 943-944, 3 figs. Los Angeles County, California, builds roads in two sections to keep traffic moving; center joint keeps autos on own side; cost figures.

Tar-Macadam v. Granite Macadam, Ellis W. Jones. Surveyor, vol. 54, no. 1399, Nov. 8, 1918, p. 220. Author's experience and recommendation that roads which have to carry from 600 to 1,000 tons a day should be maintained with tar-macadam.

Maintenance

Motor Vehicles and Their Influence Upon Road Construction, W. A. Maclean. Surveyor, vol. 54, no. 1399, Nov. 8, 1918, pp. 221-222. Record of Deputy Minister of Public Highways for Ontario.

Road Maintenance Methods and Devices Effect Saving of Material, Labor and Fuel. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 981-984, 5 figs. Bureau of Maintenance and Repair, New York State Highways Department, working through nine division engineers, endeavors to keep war-time traffic roads open and still conserve material.

Mixers

Direct Charging of Concrete Mixers. Mun. Jl., vol. 45, no. 20, Nov. 16, 1918, p. 392. Feature of construction of concrete pavement in ten-mile section of Delaware road.

Two Mixers on Variable Road Work. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 31-32, 2 figs. Methods followed in construction of a Western road.

Snow Removal

Snow Removal on Trunk Line Highways, Chas. J. Bennett. Good Roads, vol. 16, no. 20, Nov. 16, 1918, pp. 188-189. Study of the problem and suggestion for its solution. Before conference On Snow Removal from Trunk Highways, Automobile Club of America.

Surfacing

How to Get the Best Surface on a Concrete Road, A. H. Hunter. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 25-28, 2 figs. Suggestions in regard to application of forms, building of expansion joints and use of roller and belt.

Resurfacing Part of Buffalo-Albany Turnpike with Concrete, A. S. Hinman. Cement & Eng. News, vol. 30, no. 11, Nov. 1918, pp. 35-36, 3 figs. Method of carrying on work without closing traffic.

Wood Roads

Gasoline Consumption Tests Demonstrate Value of Hard, Smooth-Surfaced Roads, A. N. Johnson. Eng. News-Rec., vol. 81, no. 19, Nov. 7, 1918, pp. 843-850, 8 figs. Gasoline saving which would pay for construction of hard surface in few years is indicated between earth and smooth concrete, where daily motor traffic of 500 can be expected. Results of some tests and description of methods employed.

Paved Roadways Aid Plant Efficiency, H. Colin Campbell. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 471-472, 4 figs. Plea for better roadways around factory buildings.

The Measure of a Good Road, Robert C. Barnett. Eng. & Contracting, vol. 50, no. 19, Nov. 6, 1918, pp. 438-440, 3 figs. Mathematical treatment of thesis. Assumptions of good road; 1. A straight line is shortest distance between two points; 2. A plane of uniform slope is best grade between two points; 3. A hard, smooth surface offers less tractive resistance than rough or yielding one.

The Vital Importance of the Highway, S. M. Williams. Am. City, vol. 19, no. 5, Nov. 1918, pp. 354-355, 1 fig. Plea for establishment of Federal Highway Commission.

See also MECHANICAL ENGINEERING, Machinery, Special (Road Finisher)

SEWAGE DISPOSAL

Dilution

Sewage Disposal by Dilution. Times Eng. Supp., no. 527, Sept. 1918, p. 188. Experimental investigation of Royal Commission on Sewage Disposal into self-purifying capacity of rivers.

Direct Oxidation

Sewage Treatment in Easton. Mun. Jl., vol. 45, no. 20, Nov. 16, 1918, pp. 386-388, 4 figs. Details and method of operation of plant of 1,000,000 gal. capacity of "direct oxidation" type.

Sewer Pipe

Incrustation in Vancouver Sewer Pipe, A. G. Dalzell. Can. Engr., vol. 35, no. 19, Nov. 7, 1918, pp. 403-406, 3 figs. Objectionable features which have developed in machine-made concrete pipe, 8 to 30 in. in diameter.

Sludge Dewatering

Two Important Sludge Problems, Arthur J. Martin. Contract Rec., vol. 32, no. 48, Nov. 27, 1918, pp. 941-942. Suggestions in regard to use of compressed air and removal of water contained in sludge.

WATER SUPPLY

Consumption

Water Consumption in New York State Cities and Its Effect on Coal Consumption. Am. City, vol. 19, no. 5, Nov. 1918, pp. 376-378. From a report compiled by the State Bureau of Municipal Information of the New York State Conference of Mayors.

Mains in Winter

Waterworks Operation. Mun. Jl., vol. 45, no. 21, Nov. 23, 1918, pp. 408-410. Methods of thawing water mains and services.

Pollution

Sanitary Aspects of Water Supplies at Army Cantonments, James T. B. Bowles. Eng. & Contracting, vol. 50, no. 20, Nov. 13, 1918, p. 460. From Sept. Jl. of Am. Waterworks Assn.

Railway Water Supply

New Water Treating Plants for the Burlington. Ry. Rev., vol. 63, no. 19, Nov. 9, 1918, pp. 661-666, 10 figs. Use of reinforced-concrete tanks on Casper division; various conditions of water supply; different types of construction.

Railway Water Supply from Wells. Ry. Rev., vol. 63, no. 19, Nov. 9, 1918, pp. 669-671. From report of committee on sources of railway water supply, to Am. Ry. Bridge and Building Assn., Chicago, Oct. 15, 1918, by C. R. Knowles, chairman.

Sand Filters

Coagulants Versus Sand Filters as Aid to Water Purification in the Field, H. S. Briggs and E. R. Marle. Contract Rec., vol. 32, no. 46, Nov. 13, 1918, pp. 906-908. Description of installation embodying alum process. From Roy. Engrs. Jl.

Drifting Sand Filter, Toronto Island, Geo. G. Nasmith and N. J. Howard. Can. Engr., vol. 35, no. 17, Oct. 24, 1918, pp. 359-364, 6 figs. Report of bacteriological and physical tests performed on section comprising five filter units.

Toronto's Drifting Sand Filter. Mun. Jl., vol. 45, no. 20, Nov. 16, 1918, pp. 390-392. Construction and operation; bacteriological and physical tests; conclusions as to efficiency of plant.

WATERWAYS

Dams

High-Pressure Gates in Dams for Water-Works and Irrigation Reviewed, D. W. Cole. Eng. News-Rec., vol. 81, no. 20, Nov. 14, 1918, pp. 880-884, 5 figs. From sluice gates in Sudbury Dam of Boston Water-Works through various stages of gate development in high dams of U. S. Reclamation Service. From paper presented at Idaho conference of engineers in 1918.

Modifications in the Character of a Water Stream Produced by Construction of a Dam (Modifications apportées au régime d'un cours après l'établissement d'un barrage), K. Zorayan. Revue Générale de l'Electricité, vol. 4, no. 7, Aug. 17, 1918, pp. 226-229, 5 figs. Chart for tracing output curve knowing the declivity of a water course and the height of water in dam.

Gates

Some Experiences with Large-Capacity Reservoir Outlets, James M. Gaylord. Eng. News-Rec., vol. 81, no. 21, Nov. 21, 1918, pp. 945-950, 2 figs. Specially designed gates control discharge of immense volumes of water under pressures above 200 ft.; difficulties and how they have been overcome. Paper before Colorado Assn. of members of Am. Soc. of Civil Engrs.

Run-Off

Progress Report of Committee on Run-Off. Jl. Boston Soc. Civil Engrs., vol. 5, no. 9, Nov. 1918, pp. 387-422, 3 figs. Use of the current meter in stream gaging; 0.2 and 0.8 method in power canals; precipitation, evaporation and run-off; effects of ice on river discharge; methods to be used in compilation of data.

Stream Regulation

Stream Regulations in Quebec Province, Olivier Lefebre. Can. Engr., vol. 35, no. 19, Nov. 7, 1918, pp. 399-402 and 411, 5 figs. Account of increase in water power by using Lakes St. Francis and Aylmer as storage basins and indications of possible developments. From Annual Report of Quebec Streams Commission.

See also MECHANICAL ENGINEERING, Hydraulic Machinery.

Mining Engineering

ALLOYS, FERROUS

Electric Furnace

Two-Ton Electric Furnace Makes Alloys. Can. Machy., vol. 20, no. 20, Nov. 14, 1918, pp. 563-565, 10 figs. Equipment of plant using Héroult furnaces for non-ferrous alloys.

BIGELOW BOILERS

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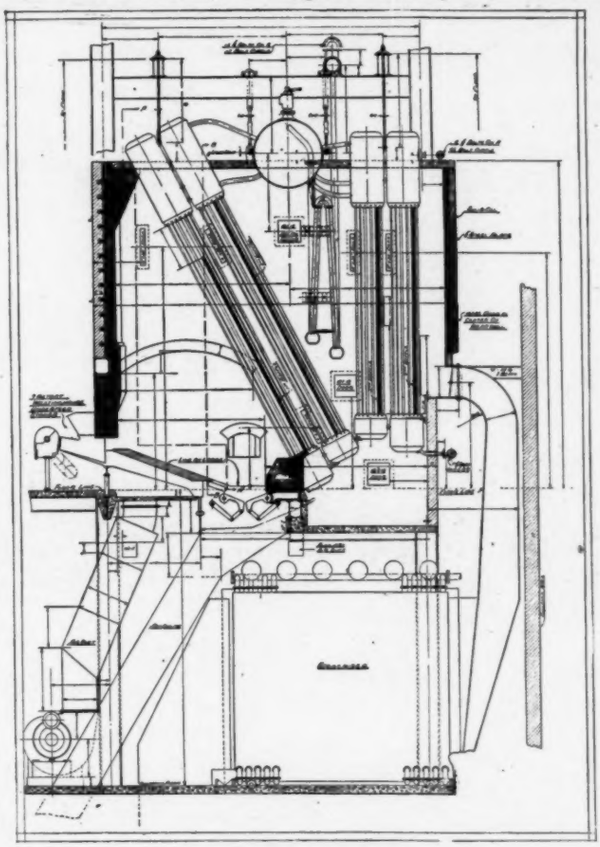

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BASE MATERIALS

Serpentine

The Origin of Serpentine, a Historical and Comparative Study, W. N. Benson. Am. Jl. of Sci., vol. 46, Dec. 1918, pp. 693-731, 4 figs. Concludes from examination of geological data that ultrabasic masses in chrysolite or antigorite-serpentine are alteration product of originally intrusive peridotite often more or less pyroxenic, and that in some cases the hydration was brought about by agency of waters emanating from same magma that produced peridotite, the change having been completed by end of one orogenic period of vulcanicity.

COAL AND COKE

Anthracite

Anthracite Production and Resources of the United States, Eli T. Connor. Can. Min. Inst., bul. no. 80, Dec. 1918, pp. 1001-1005. Map. Excerpts from address at 20th annual meeting of the Institute. Progress of the anthracite industry since 1895.

Breakers and Washeries

Hazards and Safeguards in Anthracite Breakers and Washeries, D. K. Glover. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 234-236. Recommends clearance of 7 ft. from center of track on each side. From Proc. Seventh Annual Safety Congress.

Coke Ovens

Economic Considerations in Coke-Oven Practice, W. Colquhoun. Ir. & Cl. Trds. Rev., vol. 97, no. 2646, Nov. 15, 1918, pp. 541-543. Advantages of by-product coke-ovens. Abstract of paper and discussion read before Midland Inst. of Min., Civ. & Mech. Engrs.

Instantaneous Combustion

Instantaneous Combustion of Coal and Gas at Bedford Collieries, Leigh, F. N. Siddall. Trans. Manchester Geol. & Min. Soc., vol. 35, part 10, Aug. 1918, pp. 318-325, 3 figs., and (discussion) pp. 325-327. Account of conditions in shaft before and after occurrence of an outburst.

Kentucky

The Hazard Coal Field, P. M. Sherwin. Coal Age, vol. 14, no. 23, Dec. 5, 1918, pp. 1031-1034, 11 figs. Known chiefly for its hardness and low ash content. Describes region.

Shoveling Machines

Shoveling Machines for Coal Mines. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 382-384, 4 figs. Development of mines; method of operating shoveling machines; tests under different conditions.

See also ELECTRICAL ENGINEERING, Power Applications (Coal Mining).

EXPLOSIVES

Permissible Explosives for Mine Use, J. H. Squires. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 375-379, 9 figs. Definition of permissible explosives and description of tests and appliances necessary to determine classification.

IRON

Alsace-Lorraine

Iron Ore Supplies of Alsace-Lorraine, Sidney Paige. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1149-1150. From symposium on "Certain Ore Resources of the World" prepared for meeting of Iron and Steel section, Am. Inst. of Min. Engrs., Milwaukee, October 1918.

Briquetting

Present Knowledge and Practice in Briquetting Iron Ores (V). Guy Barrett and T. B. Rogerson. Automotive Eng., vol. 3, no. 9, Oct. 1918, p. 425. The Greenwalt, West and other general processes; general observations on briquetting, its applications, cost under various processes, disadvantages and possibilities. (Concluded.)

See also ELECTRICAL ENGINEERING, Power Applications (Iron-Ore Mining).

LEAD

Flotation

The Development of Galena Flotation at the Central Mine, Broken Hill, R. J. Harvey. Instn. Min. & Met., bul. 170, Nov. 14, 1918, pp. 1-17, 7 figs. Experimental work and results.

MAJOR INDUSTRIAL MATERIALS

Manganese

Manganese Deposits in the Colorado River Region. Salt Lake Min. Rev., vol. 20, no. 15, Nov. 15, 1918, p. 30. Replacement deposits; methods and cost of mining. (Concluded.)

Sulphur

Sulphur Deposits of the Trans Pecos Region in Texas, Kirby Thomas. Eng. & Min. Jl., vol. 106, no. 23, Dec. 7, 1918, pp. 979-981, 3 figs. Origin, character of deposits, methods of mining, etc.

MINES AND MINING

Bounces

An Unusual Bounce Condition, A. C. Watts. Coal Age, vol. 14, no. 23, Dec. 5, 1918, pp. 1028-1030, 4 figs. Bounces occurred with annoying frequency. A fault was driven through and analysis made of existing conditions.

Cementing of Wells

Cement Plugging for Exclusion of Bottom Water in the Augusta Field, Kansas. Bul. Am. Inst. Min. Engrs., no. 142, Oct. 1918, pp. 1613-1620, 6 figs. Results obtained from preliminary cementing of wells in effort to cut off bottom water.

Field Tests

Field Tests for the Common Metals in Minerals. Univ. Ariz., bul. no. 93, Min. Tech. Series, no. 21, pp. 1-20. Compiled to be used as a text for lectures on "Prospector's Mineralogy."

Gas Detector

Improved Mine-Gas Detector. Min. & Eng. Rec., vol. 23, nos. 17 & 18, Sept. 30, 1918, pp. 180-181, 1 fig. Apparatus, developed by Bureau of Mines, for determining presence of inflammable gases and proportion of gas present.

Mine Timbers

Preservative Treatment of Mine Timbers as a Conservation Measure, Kurt C. Barth. Cl. Age, vol. 14, no. 23, Dec. 5, 1918, pp. 1025-1027. Three methods of application available.

Minerals Control Act

Will the Government Fulfill Its Obligations to Those Who Undertook Mineral Developments at Its Request? Mfrs. Rec., vol. 74, no. 23, Dec. 5, 1918, pp. 73-74. Discusses the Minerals Control Act and necessary protection to make the United States more self-sustained as a nation.

Rescue Apparatus

New Form of Oxygen Mine Rescue Apparatus, H. V. Manning. Min. & Eng. Rec., vol. 23, nos. 17 & 18, Sept. 30, 1918, pp. 179-180, 2 figs. Apparatus, developed by Bureau of Mines, for use poisonous or irrespirable atmospheres in mines after fires or explosions.

Stone-Dust Removal

Sprayer for Stone-Dusting in Mines, A. Rushton. Tran. Manchester Geol. & Min. Soc., vol. 35, part 10, Aug. 1918, pp. 327-329. Features of ejector which blows stone dust into atmosphere of mine by means of compressed air. Stone dust is carried from atmosphere of mine in the same way as coal dust.

Temperature Measurements

Measurement of Temperature at Great Depths (Mesure de la temperature dans les sondages à toute profondeur), M. Verzat. L'Echo des Mines et de la Métallurgie, no. 2582, July 14, 1918, p. 343. Account of the measurement of temperature at a depth of 1616 meters made by the Cie. des Mines du Sud de la Mure.

Timbering

Safe and Efficient Mine Timbering, Robert Z. Virgin. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 369-372, 12 figs. Explains and illustrates different methods and analyzes each with regard to safety and efficiency.

Transfer Chutes

Driving and Timbering Transfer Chutes, C. T. Rice. Eng. & Min. Jl., vol. 106, no. 23, Dec. 7, 1918, pp. 991-993, 3 figs. Method employed in the Coeur d'Alene district.

See also MECHANICAL ENGINEERING, Hoisting and Conveying.

MINOR INDUSTRIAL MATERIALS

Antimony, Strontium, etc.

Antimony, Graphite, Nickel, Potash, Strontium, Tin, E. S. Boalich and W. O. Castello. Cal. State Min. Bur., report no. 5, Mar. 1918, 44 pp. Properties, occurrence and uses of these substances.

Tungsten

Tungsten, Molybdenum and Vanadium, E. S. Boalich and W. O. Castello. Cal. State Min. Bur., report no. 4, Mar. 1918, 34 pp. Properties, ores, occurrence and uses of these minerals.

Wolfram Ore and Tungsten. Chem. News, vol. 117, no. 3059, Oct. 25, 1918, pp. 337-338. Report of Departmental Committee on the Eng. Trades after the War. From Jl. Roy. Soc. of Arts, vol. 66, no. 3436.

OIL

Water Troubles

Water Troubles in the Mid-Continent Oil Fields and Their Remedies, Dorsey Hager and G. W. McPherson. Bul. Am. Inst. Min. Engrs., no. 142, Oct. 1918, pp. 1620-1627, 2 figs. Classification of troubles and account of results obtained by shutting off water.

PRECIOUS MINERALS

Kalgoorlie

Kalgoorlie Goldfield. Aust. Min. Std., vol. 60, no. 1564, Oct. 31, 1918, pp. 705 and 707. Report of J. B. Jaquet on circumstances connected with certain earth tremors, presence of methane gas, systems of working, etc.

RARE MINERALS

Wilsonium

Wilsonium, Henri Bonaparte. Min. & Eng. Rec., vol. 23, nos. 17 and 18, Sept. 30, 1918, pp. 176-177. Chemical and physical nature and occurrence of new mineral named in honor of President Wilson by its discoverer, Franklin Heath.

TIN

Metallurgy

Effect of Heating and Heating and Quenching Cornish Tin Ores Before Crushing, Arthur Yates. Instn. Min. & Metallurgy, bul. 170, Nov. 14, 1918, pp. 1-3. Summary of investigation made in the laboratories of the Royal School of Mines.

Ore Handling

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A Symposium on the Conservation of Tin. A.I.M.E. bul. no. 144, Dec. 1918, pp. 1729-1764. Eight short papers.

Conserving Tin in Different Solder Mixtures, Milton L. Lissberger. Foundry, vol. 46, no. 316, Dec. 1918, pp. 579-580. Experiments indicate that the ideal alloy should contain 46 per cent tin and 54 per cent lead; preventing tin waste. From paper before Milwaukee meeting of Inst. of Metals Division of Am. Inst. of Min. Engrs.

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Dumps and Dump Hoppers, C. L. Miller. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 373-374, 2 figs. Suggestions for making layouts addressed to mining engineers having no other data at hand than details of mine car.

Metallurgy

ALUMINUM

Aluminum and Its Alloys, Dr. Rosenhain. Aeronautics, vol. 15, no. 259, Oct. 2, 1918, pp. 321-322. Uses and possibilities in aircraft. Lecture at British Sci. Products Exhibition.

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BLAST FURNACES

Fuel Economy in Blast Furnace Practice, T. C. Hutchinson. Blast Furnace, vol. 6, no. 10, Oct. 1918, pp. 419-420, 3 figs. Discussion concerning results obtained with working furnace model built for determination of efficient distribution of charge. Paper before British Iron & Steel Inst. (Concluded.)

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Bronzes

The Constitution of the Tin Bronzes, Samuel L. Hoyt. A.I.M.E., Bul., no. 144, Dec. 1918, pp. 1721-1727, 14 figs. Notes on progress made in establishing what happens over the upper heat effect.

Gases, Reducing

The Action of Reducing Gases on Hot Solid

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The Taylor Stoker

Copper, Norman B. Pilling. Bul. Am. Inst. Min. Engrs., no. 142, Oct. 1918, pp. 1567-1580, 21 figs. Studies nature of action and conditions under which it occurs and gives graphs (obtained by experimentation) showing permeability of copper to H, steam, CO and CO_2.

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The Spectroscopic Determination of Lead in Copper, C. W. Hill and G. P. Luckey. Bul. Am. Inst. Min. Engrs., no. 142, Oct. 1918, pp. 1581-1592, 4 figs. Details of apparatus and its standardization, and comparison of accuracy of quantitative spectroscopic method for determining small amounts of lead with that of standard electrolytic determination. Variations and other applications of method are found in Proc. Am. Electrochem. Soc. (1918), 32, 191, and in Met. & Chem. Engr. (1917), 17, 659.

Utah Copper Plant

The Utah Copper Enterprise, T. A. Rickard. Min. & Sci. Press, vol. 117, no. 22, Nov. 30, 1918, pp. 713-724, 16 figs. Flow sheet of mill; plan and section of Richards-Janney classifier as used in mill; flow sheet of primary and secondary crushing plants. (To be continued.)

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Mill Practice at Flotation Plant of Utah Leasing Co., H. H. Adams. Salt Lake Min. Rev., vol. 20, no. 15, Nov. 15, 1918, pp. 21-25, 4 figs. Work of reclaiming metal contents from old tailing dumps.

IRON AND STEEL

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The Prevention of Growth in Gray Cast Iron, J. E. Hurst. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1144-1145, 3 figs. Causes of phenomenon; effect of entrance of oxidizing gases and formation of case; application of dies and permanent molds. Paper before Iron and Steel Inst., London, September, 1918. Also in Engineering, vol. 106, no. 2754, Oct. 11, 1918, p. 415, 3 figs.

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Electrical Resistance of Hardened Steel, E. D. Campbell. Engineering, vol. 106, no. 2757, Nov. 1, 1918, pp. 509, 2 figs. On rate of change at 100 deg. cent., and of ordinary temperatures in electrical resistance of hardened steel. Paper before Iron and Steel Inst.

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Making Sand-Cast Forging Ingots, W. L. Booth. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1139-1140, 2 figs. Development of practice on Pacific Coast; replacing Eastern ingots; advantages claimed for sand mold. From article in October issue of Metal Trades.

Internal Stresses

Internal Stresses Developed in Metals and Alloys by Sudden Cooling (Efforts internes développés dans les métaux et alliages par l'effect d'un refroidissement rapide), M. Portevin. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 15, Oct. 7, 1918, pp. 531-533. Measurements of dimensional variations in steel specimens. Also in Revue Générale de l'Electricité, vol. 4, no. 18, Nov. 2, 1918, p. 652.

Open-Hearth Furnaces

The Principles of Open-Hearth Furnace Design, Charles H. F. Bagley. Engineering, vol. 106, no. 2754, Oct. 11, 1918, pp. 400-401, 2 figs. From paper before Iron and Steel Inst., Sept. 1918.

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Blooming Mill Now Rolling Plates. Iron Trade Rev., vol. 63, no. 23, Dec. 5, 1918, pp. 1285-1288, 4 figs. Transformation at Baldt Works, New Castle, Del. How the plan was worked out.

Electric Rolling Mill Plant. Engineer, vol. 126, no. 3276, Oct. 11, 1918, pp. 312-314, 17 figs. Principles of speed control.

The Predetermination of Power Demands of Rolling Mills (Om bestämning och förutberäkning av energiatgangen vid valsverk), Frithiof Holmgren. Bihang till Jern-Kontorets Annaler, year 19, no. 10, Oct. 15, 1918, pp. 489-515, 6 figs.

Diagonals for Designing Rolls for Billet Mills, A. R. Mitchell. Iron Age, vol. 102, no. 20, Nov. 14, 1918, facing page 1198. Tables for determining dimensions of passes when width and corner radii of billets are given.

Steel Hardening

Further Experiments on Spontaneous Generation of Heat in Recently Hardened Steel, Charles F. Brush, Robert A. Hadfield and S. A. Main. Proc. Roy. Soc., vol. 95, no. A666, Oct. 7, 1918, pp. 120-138, 7 figs. Recapitulation of previous investigations; account of recent experimental work which was confined mainly to variations of heat treatment of one particular nickel-chromium steel; presentation of empirical law which seems to regulate approximately gradual diminution of evolution of heat.

See also MECHANICAL ENGINEERING, Fuels and Firing (Waste Heat), Heat Treating.

OCCLUDED GASES

Gases in Metals. Times Eng. Supp., no. 529, Nov. 1918, p. 243. Influence on mechanical properties; opinions of scientists, industrial research workers and manufacturers. Conference of Faraday Soc.

WASTE RECUPERATION

Recuperation and Utilization of Waste of Copper, Zinc, Lead, Tin, Aluminum and Their Alloys (La recupération et l'utilisazion des déchets de cuivre, zinc, plomb, étain, aluminium et de leurs alliages), Paul Raous. Génie Civil, vol. 73, no. 13, Sept. 28, 1918, pp. 251-255, 5 figs. Electrolytic processes for recuperation of tin; recuperation of aluminum; electrolytic separation of metals entering in an alloy. (Concluded.)

See also ELECTRICAL ENGINEERING, Power Applications (Furnaces).

Aeronautics

AEROPLANE PARTS

Stick Control

The Warner Duplex Stick Control. Aerial Age, vol. 8, no. 13, Dec. 9, 1918, p. 661, 3 figs. Brief description of hand and knee grips for use of pilots.

Tail

A Gotha Biplane Tail. Flight, vol. 10, no. 40, Oct. 3, 1918, pp. 1107-1108, 1 fig. Design consisting of two horizontal approximately triangular planes, top plane being supported on cabane of steel tubes, while sides of bottom plane are bolted to sides of body.

AEROSTATICS

Military

Military Aerostatics, H. K. Black. Aerial Age, vol. 8, nos. 6, 7 and 9, Oct. 21 and 28, and Nov. 11, 1918, p. 325, 1 fig., 371, 1 fig. and 475, 2 figs. Oct. 21: Balloon baskets. Oct. 28 and Nov. 11: Equipment of basket. (Continuation of serial.)

AIRCRAFT PRODUCTION

U. S. Navy

Naval Aircraft Factory at Philadelphia. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 465-470, 13 figs. Story of great industrial achievement of United States Navy.

APPLICATIONS

Exploration

The Possibility of Aerial Reconnaissance in the Himalaya, A. M. Kellas. Aeronautics, vol. 15, no. 257, Sept. 18, 1918, pp. 275-277. Fundamental facts and requirements of undertaking. Paper before Roy. Geog. Soc.

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Building for the Aviation Service, M. E. Hoag. Am. Mach., vol. 49, no. 23, Dec. 5, 1918, pp. 1043-1044, 7 figs. Building a 3½-ton special truck for U. S. Aviation Signal Service. First article.

DYNAMICS

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Elementary Considerations on the Ceiling of an Airplane (Données élémentaires sur le plafond d'un avion), André Lainé. l'Aérophile, year 26, nos. 17-18, Sept. 1-15, 1918, pp. 264-265. Points out convenience of high ceiling and means of attaining it.

On an Experience of the Flyer Gilbert (Sur une expérience du pilote Gilbert), F. Roux. l'Aérophile, year 26, nos. 17-18, Sept. 1-15, 1918, p. 263, 1 fig. How it happened that Eugène Gilbert maintained his plane stationary in air while machine was running at full speed.

Stability

Lateral Stability in Aeroplanes, C. Levick. Aerial Age, vol. 8, no. 13, Dec. 9, 1918, p. 660, 3 figs. Computation of effect of a roll on a machine in terms of dihedral angle of aerofoils. Also in Flight, vol. 10, no. 42, Oct. 17, 1918, p. 1165, 3 figs.

ENGINES

Austro-Daimler

The 200-Hp. Austro-Daimler Aero Engine. Engineer, vol. 126, nos. 3279 and 3280, Nov. 1 and 8, 1918, pp. 376-379, 10 figs, 393-394, 7 figs. Description of details, with principal data and illustrations. Also in Flight, vol. 10, nos. 44 and 45, Oct. 31 and Nov. 7, 1918, pp. 1217-1222, 10 figs., and 1255-1259, 12 figs.; Engineering, vol. 106, no. 2757, Nov. 1, 1918, pp. 488-492, 17 figs.; Aeronautics, vol. 15, no. 263, Oct. 30, 1918, pp. 403-417, 27 figs.

Design

The Design of Airplane Engines (II), John Wallace. Automotive Eng., vol. 3, no. 9, Oct. 1918, pp. 415-417 and 401, 3 figs. Comparison of rotary and fixed radial motors; trend of modern design; cooling of cylinders; indicator diagram; compression ratio. From Aeronautics. (Continuation of serial.)

History

Outline of History of Aviation Engine Production, H. H. Emmons. Aerial Age, vol. 8, no. 13, Dec. 9, 1918, pp. 662-665, 2 figs. Elementary training engines; development of Liberty 12; methods of production. Also in Motor Age, vol. 34, no. 23, Dec. 5, 1918, pp. 18-19 and 30, 3 figs.

Liberty

American Liberty Motor (Le moteur Américain Liberty). l'Aérophile, year 26, nos. 17-18, Sept. 1-15, 1918, p. 271. Abstract of description authorized by War Department. Also in Sci. Am., vol. 99, no. 23, Dec. 7, 1918, pp. 455 and 466, 4 figs.

Maybach

The 300-Hp. Maybach Aircraft Engine. Automotive Ind., vol. 39, nos. 18, 20 and 21, Oct. 31, Nov. 14 and 21, 1918, pp. 755-759, 8 figs., 840-843, 9 figs., 882-887, 5 figs. Technical description of largest German Aircraft engine model. Issued by Tech. Department, Aircraft Production, Ministry of Munitions. Nov. 14: Lubricating System; details of oil pumps; cooling and ignition systems; carburetor and fuel feed system. Nov. 21: Results of horsepower and fuel consumption tests; table of engine dimensions; general analysis of weights; chemical and physical analysis of material in various parts. Also in Automobile Engr., vol. 8, no. 119, Oct. 1918, pp. 285-295, 27 figs.; Flight, vol. 10, no. 39, Sept. 26, 1918, pp. 1084-1087, 2 figs.

Panhard

The Panhard—300 Hp. (Direct Type Aviation Motor), E. H. Sherbondy. Aerial Age, vol. 8, no. 6, Oct. 21, 1918, pp. 308-309, 5 figs. Motor with two rows, each of six cylinders, inclined 60 deg. to each other.

GLIDERS

An Interesting Biplane Glider, F. J. Camm. Aeronautics, vol. 15, no. 262, Oct. 25, 1918, p. 393. Chief dimensions and process of construction.

HISTORY

Langley

What Langley Did for the Science of Aviation (II). Automotive Ind., vol. 39, no. 17 and 18, Oct. 24 and 31, 1918, pp. 714-718 and 728, 10 figs., and 761-765, 7 figs. Experiments with rubber-driven models and others using compressed air, carbonic acid gas and electric batteries; adoption of steam as source of power. Oct. 31: Experiments with quarter-size and man-carrying aerodromes. (To be continued.)

INSTRUMENTS

Barograph

German Barograph No. 1623, Range 0 to 8000 m. Flight, vol. 10, no. 42, Oct. 17, 1918, pp. 1167-1168, 6 figs. General remarks on details of construction. Also in Aeronautics, vol. 15, Oct. 23, 1918, pp. 382-384, 6 figs.

Instruments for Air Use, W. A. Robson. Sci. Am. Supp., vol. 86, no. 2235, Nov. 2, 1918, p. 285. From Flight.

MATERIALS OF CONSTRUCTION

Steel Tubes

Steel Tubes, Tube Manipulation, and Tubular Structures for Aircraft, W. W. Hackett and A. G. Hackett. Flight, vol. 10, no. 44, Oct. 31, 1918, pp. 1233-1235. Tapered tubes; tubular liners or reinforcements; tubular joints in aircraft construction; tests on soldered joints; brazing; welding; rust prevention. (Concluded.) Also in Automotive Eng., vol. 3, no. 9, Oct. 1918, p. 396 and (discussion) pp. 397-398.

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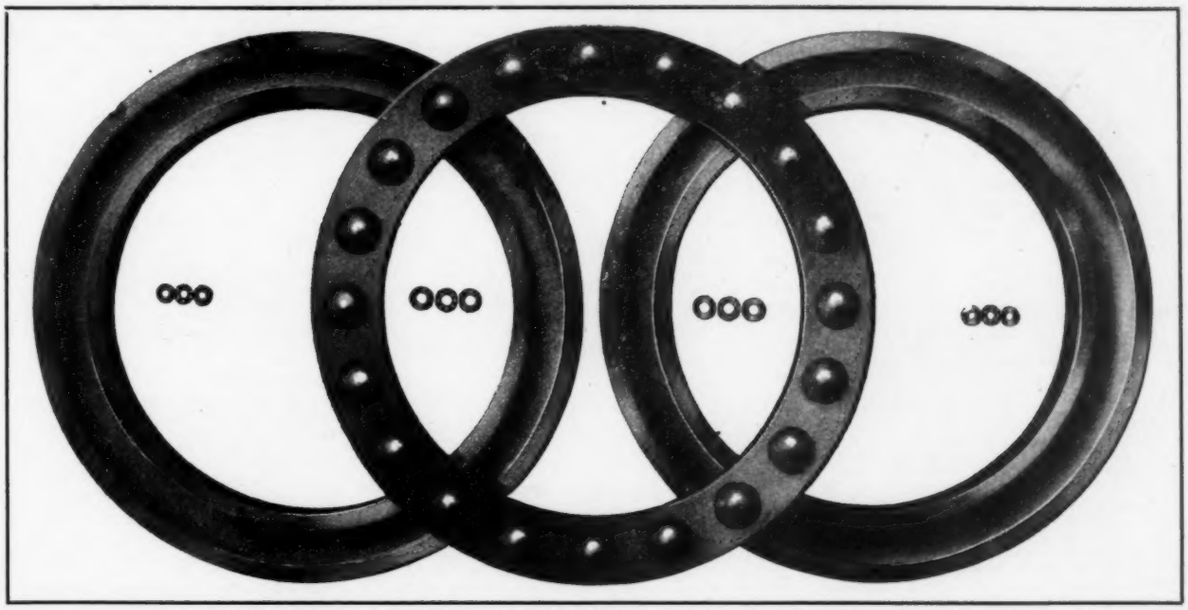

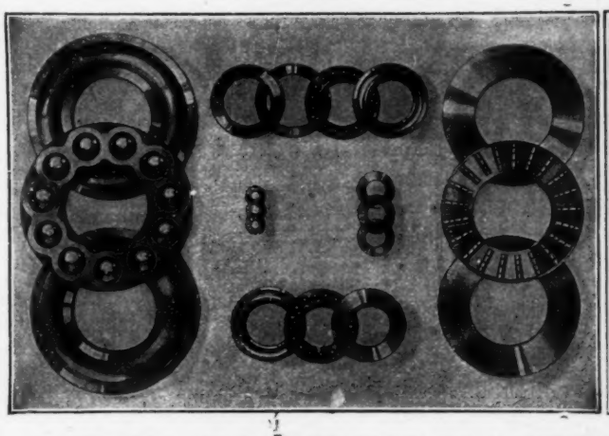

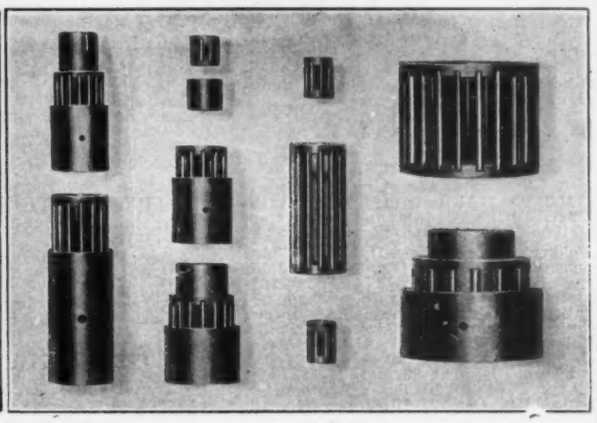

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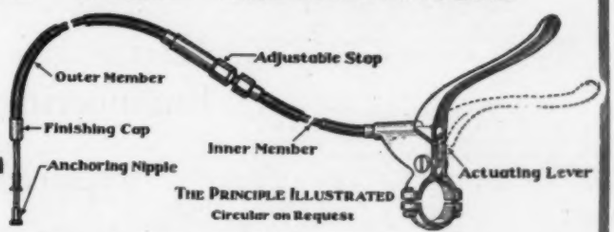

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See also MECHANICAL ENGINEERING, Measurements (Permeability).

METEOROLOGY

Meteorology in Relation to Aeronautics (1), W. H. Dines. Sci. Am. Supp., vol. 86, no. 2239, Nov. 30, 1918, pp. 351-352. Review of data required by an aviator when in the air. Paper before Aeronautical Soc. of Gt. Britain. From Aeronautical Jl.

MILITARY AIRCRAFT

British

Some Recent Types of Allied Military Planes. Automotive Ind., vol. 39, no. 17, Oct. 24, 1918, pp. 706-707, 4 figs. General features of Spad single-seater tractor scout, Vickers F B-14, long-distance reconnaissance tractor biplane, Sopwith "Hippo" two-seater fighter, and Avro training machine.

German

German Aircraft. Times Eng. Supp., no. 527, Sept. 1918, p. 198. Abstract of five reports of Technical Department, Aircraft Production, Ministry of Munitions, describing Maybach engine, Rumpler two-seater biplane, Hannoveraner biplane, an armored machine, and Pfalz scout.

MODELS

Model Construction

Model Aeroplane Building as a Step to Aeronautical Engineering. Aerial Age, vol. 8, nos. 6, 7, 8 and 9, Oct. 21, 28 and Nov. 4, 11, 1918, p. 377, 7 figs., 389, 1 fig., 433 and 483, 1 fig. Oct. 21: Construction of vertical stabilizer. Oct. 28: Designing and building of a man-carrying aeroplane. Nov. 4 and 11: Calculation of sustaining power and resistance of wings and explanation of table giving aerodynamic laboratory tests. (Continuation of serial.)

Model Aeroplanes (XVI), F. J. Camm. Aeronautics, vol. 15, no. 258 and 261, Sept. 25, Oct. 16, 1918, p. 300, 1 fig., 369, 2 figs. Details of a tractor monoplane. Oct. 16: Notes on attaching elastic and on manner of flying model.

Model Testing

The Theoretical Basis of Model Strength Tests for Aeroplane Structures, W. L. Cowley and H. Levy. Aerial Age, vol. 8, no. 6, Oct. 21, 1918, pp. 322-323. Application of principle of homogeneity of dimensions to determination of strength of structure.

PLANES

A. E. G.

A. E. G. Armoured Aeroplane. Engineering, vol. 106, no. 2754, Oct. 11, 1918, pp. 416-417, 15 figs. Principal data and description, with details of construction illustrated.

The Fokker Biplane, Type D VII. Flight, vol. 10, nos. 40, 41 and 42, Oct. 3, 10, and 17, 1918, pp. 1109-1116, 1142-1144 and 1161-1164, 23 figs. Data relating to performance and detailed particulars of weights. Issued by Technical Department, Aircraft Production, Ministry of Munitions. Also in Aerial Age, vol. 8, no. 8, Nov. 4, 1918, pp. 424-427, 20 figs.; l'Aérophile, year 26, nos. 17-18, Sept. 1, 1918, pp. 257-262, 10 figs.; Aeronautics, vol. 15, no. 259, Oct. 2, 1918, pp. 310-316, 23 figs.

A. R.

The French A. R. Biplane. Aerial Age, vol. 8, no. 7, Oct. 28, 1918, pp. 374-375, 6 figs. Particulars of two-strutter biplane of 13.3 m. span which has its fuselage supported between planes on ash struts.

Berg

The Austrian Berg Single-Seater. Flight, vol. 10, no. 44, Oct. 31, 1918, pp. 1225-1227, 7 figs. Mounting of 200-hp. Austro-Daimler engine with which plane is equipped; tanks; instruments; control; undercarriage. (Continuation of serial.)

Continental

The Continental Kb-3T Training Tractor, John F. McMahon. Aerial Age, vol. 8, no. 6, Oct. 21, 1918, pp. 316-317 and 345, 4 figs. General specifications of machine designed for cheap construction by the Continental Aircraft Corporation.

Halberstadt

Report on the Halberstadt Fighter. Flight, vol. 10, no. 41, Oct. 10, 1918, pp. 1133-1141, 38 figs. Details of performance and construction. Issued by Technical Department, Aircraft Production, Ministry of Munitions. Supplementing brief description given in issue of Aug. 1. Also in Engineer, vol. 126, no. 3276, Oct. 11, 1918, pp. 302-304, 25 figs.

Pfalz

Report on the Pfalz Single-Seater (G141). Aeronautics, vol. 15, no. 257, Sept. 18, 1918, pp. 270-274, 22 figs. Particulars and performance of German scout with streamline-shaped fuselage. By Technical Department, Aircraft Production, Ministry of Munitions.

Roland

The Roland Chaser D II, G. Douglas Wardrop. Aerial Age, vol. 8, no. 6, Oct. 21, 1918, pp. 310-312, 9 figs. Construction of fuselage, planes, tail, engine, and undercarriage.

Siemens-Schuckert

A New German Chaser. Flight, vol. 10, no. 39, Sept. 26, 1918, p. 1083, 2 figs. Characteristics of Siemens-Schuckert biplane.

Sopwith

The Sopwith "Camel." Automotive Ind., vol. 39, no. 19, Nov. 7, 1918, pp. 790-791, 6 figs. Description of late model of British scout plane. Translated from German aircraft publication.

Zeppelin

The Zeppelin Biplane, Jean Lagorgette. Sci. Am. Supp., vol. 86, nos. 2237 and 2238, Nov. 16 and 23, 1918, pp. 316-319 and 334-335, 8 figs. Description of German bombing machine 134 ft. long. From Aeroplane.

PRODUCTION

Standardization

Effect of Changes on Airplane Output. Ind. Man., vol. 56, no. 5, Nov. 1918, pp. 375-377. Manufacturers must abandon idea of standardized production.

PROPELLERS

Analysis

Notes on Airscrew Analysis (III), M. A. S. Riach. Aeronautics, vol. 15, no. 257, Sept. 18, 1918, pp. 265-266. Outlines process by which experimental results on airscrews are analyzed and compared with their respective calculated performances. (Concluded.)

Calculations

Calculating Airplane Propeller Strength and Efficiency (II), F. W. Caldwell. Automotive Eng., vol. 3, no. 9, Oct. 1918, pp. 402-405. Limit of ceiling, comparison of conventional designs; calculations of efficiency during climbing; calculations for propeller chart. (Concluded.)

SPECIFICATIONS, AEROPLANE

U. S. Navy

Navy Department Airplane Specifications. Jl. Soc. Automotive Engrs., vol. 3, no. 5, Nov. 1918, pp. 325-329. Issued for use in connection with contracts and submission to Navy of new and undemonstrated designs.

TRANSATLANTIC FLIGHT

Transatlantic Flight, Frithiof G. Ericson. Jl. Soc. Automotive Engrs., vol. 3, no. 5, Nov. 1918, pp. 319-321. Favorable routes; requirements of airplane; flight endurance. From Aviation.

Marine Engineering

AUXILIARY MACHINERY

Boats

Boat Lowering Appliances. J. R. Hodge. Tran. Inst. Marine Engrs., vol. 30, Aug. 1918, pp. 123-127, 4 figs and (discussion) 127-136, 1 fig. Type of disengaging gear designed to deal simultaneously and automatically at both ends of boat, to free it from davit falls or tackles as soon as boat is water-borne.

General Rules and Regulations Prescribed by the Board of Supervising Inspectors as Amended at Board Meeting of January, 1918. Department of Commerce, Steamboat-Inspection Service, Aug. 1, 1918, 147 pp., 5 figs. Rules for boiler plate, boilers and attachments, boats and their appliances, steamers, barges and duties of inspectors; list of instruments, machines and equipments approved for use on vessels.

Diving Bell

Diving Bell in Use at Halifax Ocean Terminals, J. J. Mac Donald. Jl. Eng. Inst. Can., vol. 1, no. 6, Oct. 1918, pp. 252-262, 14 figs. Outline of function design, construction and operation; formulation of principles of design proposed as applicable to future work; survey of fields of activity where plant of this type promises applicability.

SALVAGE

Salvage Methods

Salvage of Wrecked Ships (Le sauvetage des navires coulés), A. Poidloué. Génie Civil, vol. 73, no. 13, Sept. 28, 1918, pp. 241-244, 6 figs. Review of processes used and considerations on probability of future developments.

Turning Vessel

Salvaging the Steamship St. Paul, Charles M. Horton. Int. Mar. Eng., vol. 23, no. 11, Nov. 1918, pp. 644-648, 6 figs. Methods used in turning vessel; character of problems solved; placing patch under difficulties.

SHIPS

Canada

A Canadian Shipbuilding Industry, Thomas Cantley. Can. Min. Inst., bul. no. 80, Dec. 1918, pp. 995-1000. Excerpts from paper at 20th annual meeting of the Institute. The question of developing steel shipbuilding in Canada.

Concrete Ships

Concrete Ship Design, R. J. Wig. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, pp. 15-17, 9 figs. Summary of conclusions on advisability of constructing concrete ships reached by Concrete Ship Department, Emergency Fleet Corporation. From Special Report to Chairman of Shipping Board. Also in Eng. News-Rec., vol. 81, no. 20, Nov. 14, 1918, pp. 903-904, 3 figs.

Different Types of Framing in Two New Government Reinforced-Concrete Ships. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 986-989, 6 figs. 7500-ton oil tanker has close-spaced frames with vertical and horizontal reinforcing in shell, while 2500-ton schooner barge has long-span framing system with diagonal shell reinforcement.

Reinforced-Concrete Barges (Barca de hormigon armado), Julio Murúa. Revista de Obras Publicas, year 66, no. 2245, Oct. 3, 1918, pp. 493-497, 10 figs. Calculations of design for 60-ft. barge.

Reinforced Concrete Vessels, Walter Pollock. Can. Engr., vol. 35, no. 17, Oct. 24, 1918, pp. 367-373, 5 figs. Considerations of design and ideals aimed by builders; strength; advantages and disadvantages; classification rules; structural details of hull, steelwork and fittings. Paper before British Instn. of Naval Architects.

Duct Keels

Improvements in the Construction of Ships, E. F. Spanner. Shippbuilding and Shipping Rec., vol. 12, no. 9, Nov. 7, 1918, pp. 451-452. Discusses question of duct keels. Before Instn. Engrs. & Shipbuilders.

Isherwood Framing

Large Freighters of Isherwood Framing Adapted to Bridge-Shop Fabrication. Eng. News-Rec., vol. 81, no. 19, Nov. 7, 1918, pp. 853-857, 4 figs. Problems worked out by coöperation of naval architect and engineer of barge shop; 200 tons weight saved; time gained in detailing; all molded work done in large shop at shipyard.

Reduction Gearing

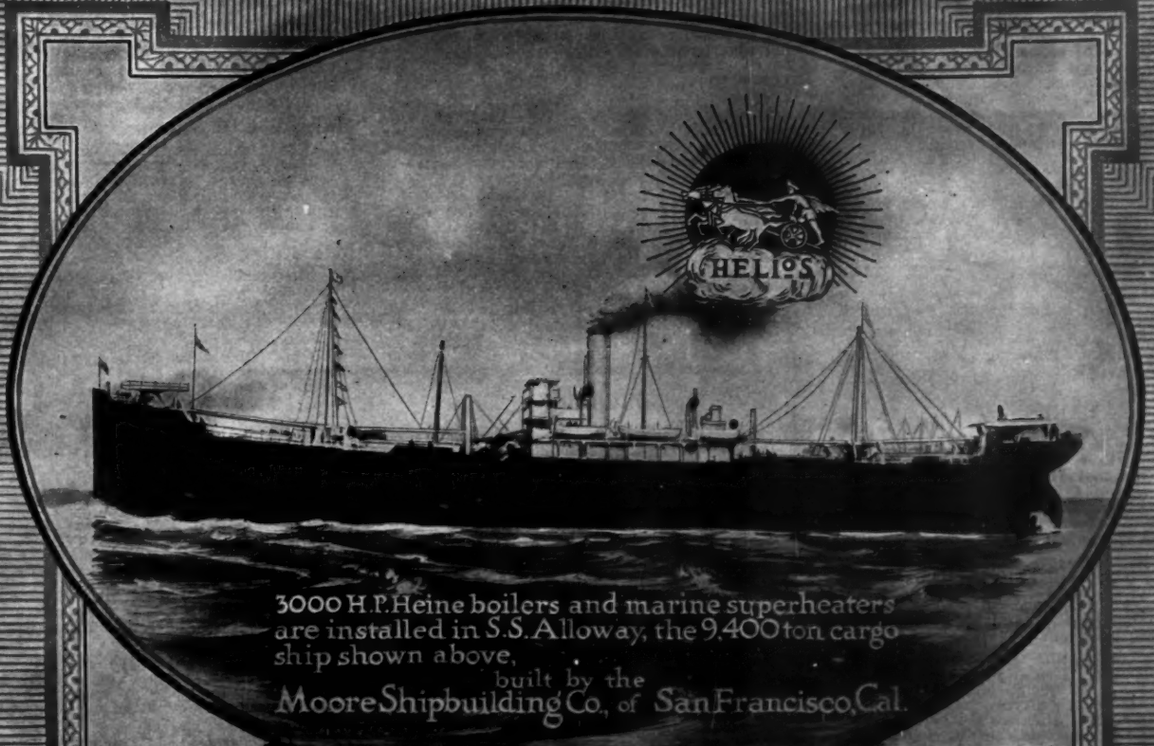
Italian Reduction-Geared Turbine Cargo-Steamship "Ansaldo I." Shipbuilding & Shipping Rec., vol. 12, nos. 19 and 20, Nov. 7 and 14, 1918, pp. 447-450, 13 figs., 470-471, 4 figs. Principal dimensions, plans and photographs.

Resistance

Effect of Appendages on Resistance and Propulsion. Shipbuilding & Shipping Rec., vol. 12, no. 19, Nov. 7, 1918, pp. 452-453, 2 figs. Account of Luke's experiments with various angles of bossing, with outward- and inward-turning screws; values of wake fractions and hull efficiencies; resistance compared with resistance of naked model. (Concluded.)

Rolling

The Rolling of Ships. Sci. Am. Supp., vol. 86, no. 2236, Nov. 9, 1918, p. 299. Factors upon which natural period of roll of a ship depends; results obtained by Froude with his apparatus to record angles of roll. From Shipping World.



3000 H.P. Heine boilers and marine superheaters are installed in S.S. Alloway, the 9,400 ton cargo ship shown above, built by the Moore Shipbuilding Co., of San Francisco, Cal.

BELOW THE WATER LINE

Uncle Sam demanded quality ships as well as quantity. We furnished and are still furnishing both. Nobody has yet questioned Heine quality or efficiency.

As for quantity, boilers for hundreds of thousands of tons dead weight capacity are now being built in the Heine plants in St. Louis and Phoenixville.

The Heine idea now predominates in marine circles. The Heine is unquestionably the boiler for land and sea.

HEINE SAFETY BOILER COMPANY

5319 MARCUS AVENUE ST. LOUIS, MO.

Standardized Ships

Structural Steel Standardized Cargo Vessels, Henry R. Sutphen. Inst. Mar. Eng., vol. 23, no. 12, Dec. 1918, pp. 695-698, 1 fig. How quantity production was met.

Stresses

Investigation of Shearing Force and Bending Moment on Ship Structures, A. M. Robb. Int. Mar. Eng., vol. 23, no. 11, Nov. 1918, pp. 637-642, 8 figs. Moderate amplitudes of heave; sagging bending moment; pitching treated graphically; effect of rotational acceleration. (Second article.)

Tow Boats

Plans and Specifications of New Wood Tow Boats. Inst. Mar. Eng., vol. 23, no. 12, Dec. 1918, pp. 673-674, plate, 1 fig. Built for hard service.

Wooden Ships

Building Wooden Ships for the Emergency Fleet Corporation, E. A. Suverkrop. Am. Mach., vol. 49, no. 20, Nov. 14, 1918, pp. 383-387, 11 figs. Planking and interior work. Third article.

YARDS

Canada

Canadian Vickers Shipbuilding Works at Montreal. Engineering, vol. 106, no. 2754, Oct. 11, 1918, pp. 395-396, 12 figs. Illustrated description of shipbuilding in Canada.

Departamental Organization

Effective Arrangement of Departments in Shipyard Organization, G. F. S. Mann. Int. Mar. Eng., vol. 23, no. 11, Nov. 1918, pp. 615-617. Shipyard divisions; relations between organization departments and production departments; duties of chief engineer.

New Lake Shipyard has Side-Launching Ways Under Cover. Eng. News-Rec., vol. 81, no. 19, Nov. 7, 1918, pp. 839-841, 3 figs. Ships built at Ferguson yard fabricated in company's shops two miles away; berths covered with cantilever roof served by semi-gantry crane.

Great Lakes

Great Lakes Yards Lead Coast Districts in Building Ocean-Going Ships. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 978-980, 4 figs. Canal-size steamers produced in large numbers; spirit of coöperation; yard capacity doubled; no outside fabrication; equipment of varied character; labor shortage.

Shooter's Island

Methods Used at Shooter's Island for Constructing Standard Ships, Charles M. Horton. Int. Mar. Eng., vol. 23, no. 11, Nov. 1918, pp. 618-624, 13 figs. Serving individual ways; method for increasing output; well-lighted boiler shop; handy plate-lifting clamp.

See also ELECTRICAL ENGINEERING, Power Applications (Ship Propulsion); MECHANICAL ENGINEERING, Internal-Combustion Engines (Marine Engines).

Organization and Management

ACCOUNTING

Army

Accounting Systems in Army Camps, E. J. Holmes. Jl. Actcy., vol. 26, no. 6, Dec. 1918, pp. 429-435. Explains the system used by the U. S. Army in connection with the disbursement of funds appropriated by Congress.

Carrying on with the Accountants in the American Expeditionary Forces, C. B. Holloway. Jl. Actcy., vol. 26, no. 6, Dec. 1918, pp. 412-416. Specific operations carried on by the accounting personnel.

Cost Accounting

Cost Accounting to Aid Production (III), G. Charter Harrison. Indus. Management, vol. 56, nos. 5 and 6, Nov. and Dec. 1918, pp. 456-463, 2 figs, and 391-398, 1 fig. Emphasizes necessity of cost-accounting system and illustrates its planning with diagram showing basic features of simple system for a business manufacturing various kinds of standard machines. (Continuation of serial.)

Duties of a Factory Cost Accountant, Joseph Gill. Jl. Actcy., vol. 26, no. 6, Dec. 1918, pp. 441-449. A thesis presented at the May examinations of the Am. Inst. of Accountants. Routine work of cost accountants.

Setting Production Standards for Industrial Accounting and Engineering, F. J. Knieppel. Jl. of Accountancy, vol. 26, no. 5, Nov. 1918, pp. 361-375. Explains methods of determining four basic standards.

Inventories

Verification of Inventories, A. L. Philbrick. Jl. Actcy., vol. 26, no. 6, Dec. 1918, pp. 417-428. Briefly outlines the work of the auditor and his responsibilities. Difficulties involved in the verification of the inventory.

Mail Order

Mail Order Accounting, Harry L. Cavanagh. Jl. Actcy., vol. 26, no. 6, Dec. 1918, pp. 436-440. A thesis presented at the May examinations of the Am. Inst. of Accountants.

Power House

Economics of the Power House, L. W. Alwyn-Schmidt. Power Plant Eng., vol. 22, no. 23, Dec. 1, 1918, pp. 949-952. Problem of power-house accounting approached from point of view of economist.

EDUCATION

Training of Employees

Packard Training Schools for Employees, D. G. Stanbrough. Indus. Management, vol. 56, no. 5, Nov. 1918, pp. 378-382, 13 figs. Four schools operated; for men, women, instructors for women and for job setters and foremen.

Vestibule School of Lincoln Motor Co., J. M. Eaton. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 452-455, 10 figs. Equipment of training rooms; system of instruction in machine-shop practice.

Soldiers

Vocational Training for Returned Soldiers. Jl. Eng. Inst. Can., vol. 1, no. 7, Nov. 1918, pp. 333-334. Work being done at Toronto and McGill Universities.

University

The Khaki University. Can. Min. Inst., bul. no. 80, Dec. 1918, pp. 985-989. Letter from F. D. Adams giving an account of the work and plans for future development.

FACTORY MANAGEMENT

Boiler Shop

Business Equipment in the Boiler Shop, Edwin L. Seabrook. Boiler Maker, vol. 18, no. 11, Nov. 1918, pp. 305-307. Suggests items of business conduct in boiler making plant.

Employment Manager

The Employment Manager, Edward D. Jones. Wood-Worker, vol. 37, no. 9, Nov. 1918, pp. 38-39. Organization and direction of course offered gratis to representatives of manufacturers by Management Division of War Industries Board.

The Employment Manager in Our Shipyards, Edward B. Jones. Int. Mar. Eng., vol. 23, no. 11, Nov. 1918, pp. 612-614. Duties of general executive; importance of schools; wage system and ideal service; psychology of mass action.

Foremen

Instructions to Assistant Foremen, George H. Shepard. Indus. Man., vol. 56, no. 5, Nov. 1918, pp. 403-407. Prepared by plant working extensively on governmental orders to inspire and guide minor executives.

Industrial Organization

After-War Economics of Engineering. Times Eng. Supp., no. 529, Nov. 1918, pp. 225-226. Sugests that plants review their methods of manufacture and adopt convenient modifications when necessary. Illustrations of practical procedure by reference to foundry work.

Industrial Organization as it Affects Executives and Workers, Charles E. Knoeppel. Jl. Am. Soc. Engrs., vol. 40, no. 12, Dec. 1918, pp. 1031-1033. Proposes rules of efficient organization for practical guidance of executives in developing system of industrial relationship. Presented at annual meeting of the Soc.

Management—The Solution of the Shipbuilding Problem, W. L. Churchill. Indus. Management, vol. 56, no. 5, Nov. 1918, pp. 361-366, 2 figs. Based on study of conditions in 20 shipyards and pointing to management as developed recently in other industries as proper solution to problems.

Practical System in Factory Operations, M. H. Potter. Can. Machy., vol. 20, no. 20, Nov. 14, 1918, pp. 559-560, 6 figs. Forms of charts developed from investigation of actual case.

Scientific Management Simplified, Malcolm Keir. Sci. Monthly, vol. 7, no. 6, Dec. 1918, pp. 525-529. Adaptability of scientific management to industry; fundamental elements of scientific management.

Industries

New Industries, H. W. Gepp. Aust. Min. Std., vol. 60, no. 1564, Oct. 31, 1918, pp. 686-688. Address with discussion before Soc. of Chem. Ind., Melbourne. Essential factors in the successful development of new industries in a young country.

Mechanical Department

Coördination in the Mechanical Department, W. U. Appleton. Ry. Rev., vol. 63, no. 22, Nov. 30, 1918, pp. 773-774. Recommendations for system and harmony within department and with other departments. Paper before Canadian Ry. Club, Oct. 1918.

Rate Setting

Mastering Power Production, Walter N. Polakov. Ind. Man., vol. 56, no. 5, Nov. 1918, pp. 399-403, 6 figs. Conservation of labor, power and fuel in relation to rates. Tenth article.

Time Studies for Rate Settings on Gisholt Boring Mills, Dwight V. Merrick. Indus. Management, vol. 56, no. 5, Nov. 1918, pp. 409-411, 1 fig. Fifth article.

Routing

About the Handling of Mill Work (II), Chas. Cloukey. Wood-Worker, vol. 37, no. 9, Nov. 1918, pp. 23-24, 1 fig. Part which routing of work through mill has in economical production.

Task Setting

The Human Factor in Task Setting, W. E. Camp. Indus. Management, vol. 56, no. 5, Nov. 1918, pp. 372-374, 1 fig. Chief conditions that affect factor; how they are evaluated; how to predetermine proper allowance.

Tool Department

Continuous Tooling. Times Eng. Supp., no. 527, Sept. 1918, p. 183. Suggests a means of obtaining increased output from machine-shop tools.

Tool Department of Winchester Works. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1129-1133, 4 figs. Virtually on factory production basis, workers being trained for single type operation; preparation section's important functions.

See also MARINE ENGINEERING, Yards; AERONAUTICS, Production.

FINANCE AND COST

Capital

Capital: Its Waste and Its Conservation, Archibald P. Main. Gas Jl., vol. 144, no. 2894, Oct. 29, 1918, pp. 249-251, and (discussion) pp. 251-252. Means by which author judges British industry can make best use of available credit and financial accommodation. Paper before Soc. of British Gas Industries.

INSPECTION

Graphic Control

Graphic Production Control, C. E. Knoeppel. Indus. Management, vol. 56, nos. 5 and 6, Nov. and Dec. 1918, pp. 383-390, 17 figs, 496-502, 14 figs. Controlling materials and operations. Fourth Article.

Production Records

Keeping Close Track of Shop Operation, Robert I. Clegg. Iron Age, vol. 102, no. 21, Nov. 21, 1918, pp. 1251-1253, 6 figs. Records of production and labor bulletined to management; reports with alarm-clock attachment.

Supervision

Mechanical Department Supervision, Frank McManamy. Ry. Mach. Eng., vol. 92, no. 11, Nov. 1918, pp. 597-598. Better supervision and more of it needed to keep up shop output. From paper before New York Ry. Club.

See also MECHANICAL ENGINEERING, Foundries (Supervision).

LABOR

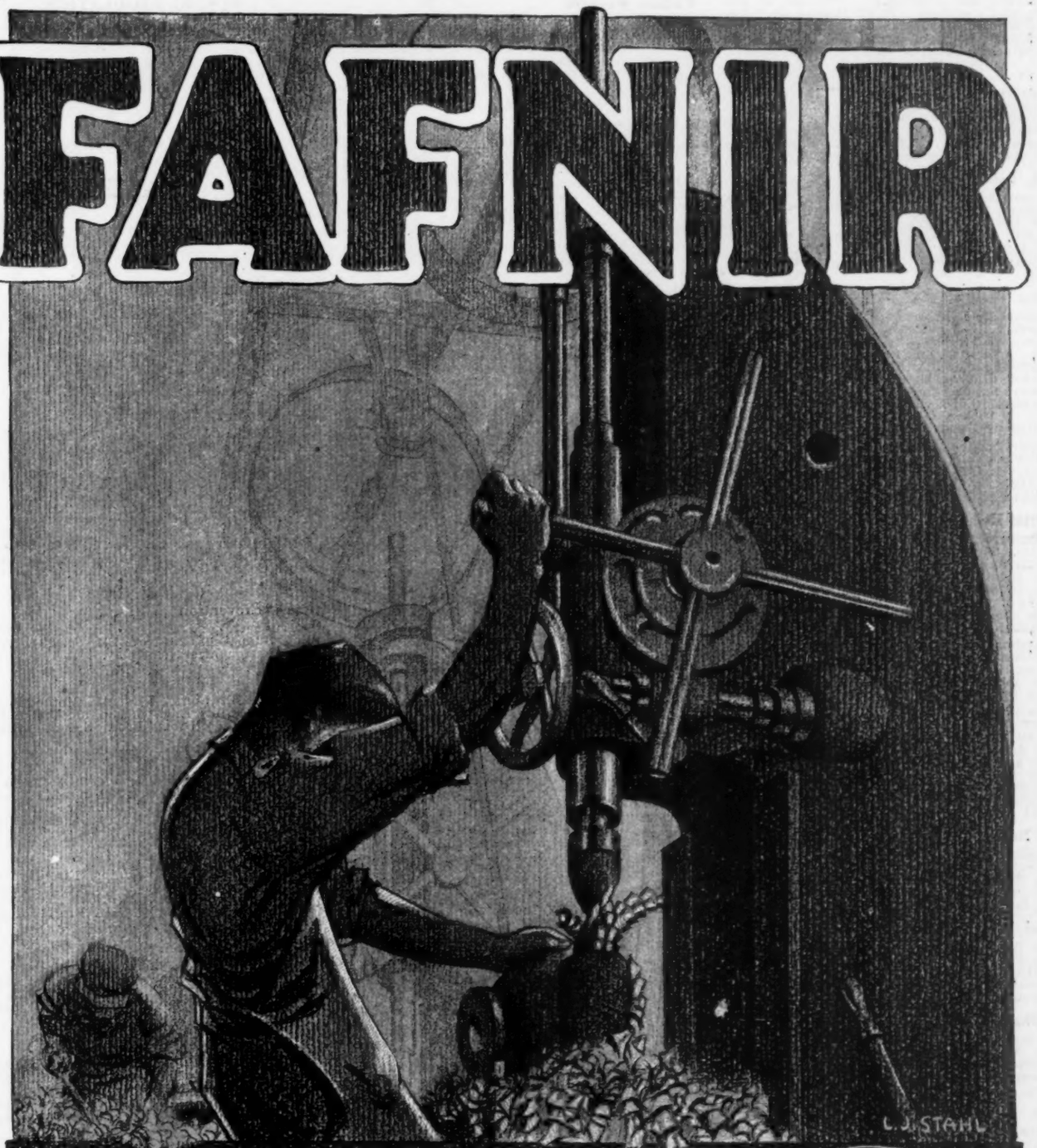
Bargaining (including collective systems)

Agreement vs. Bargaining, Harry Tipper. Automotive Ind., vol. 39, no. 19, Nov. 7, 1918, pp. 784-785. Claims confidence between employer and employee is impossible so long as both base their relations upon their ability to take advantage of a bargain.

Handling Employment Relations Without Help from the Outside. Automotive Ind., vol. 39, no. 17, Oct. 24, 1918, pp. 722-723, 1 fig. Collective-bargaining plan for handling all matters relating to wages, hours of labor, discipline, discharges and grievances.

Important Phases of the Labor Problem, Magnus W. Alexander. Iron Age, vol. 102, nos. 21 and 22, Nov. 21 and 28, 1918, pp.

FAFNIR



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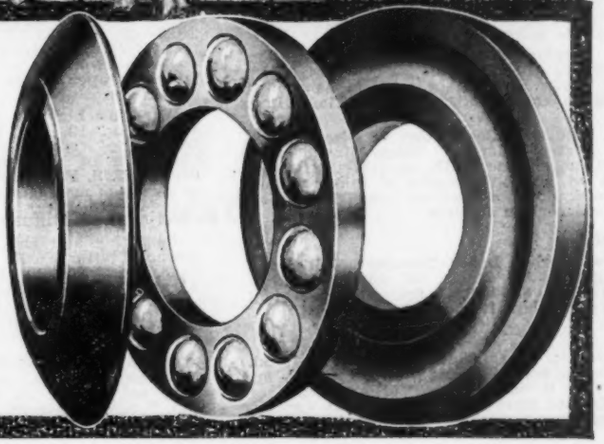
One of the chief sources of possible power loss experienced in connection with the operation of heavy duty drills is found in the excessive friction which results when inadequate provision is made for carrying the severe thrust load reacting upward through the spindle. For this application the ball bearing is far more efficient than any other type.

Fafnir Thrust Ball Bearings are standard in the products of many prominent drill manufacturers.



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1258-1261 and 1322-1325. Problems of pensions and insurance; profit sharing in industry; adjustment of labor disputes; working conditions; hours of work. Nov. 21: Recruiting of men; collective bargaining discussed.

Bonuses

Paying Bonuses to Power Plant Employees, Frederick L. Ray. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 493-495, and (discussion) pp. 495-497. Account of system followed by Milwaukee Elec. Ry. & Light Co. Paper before Nat. Assn. of Stationary Engrs.

British Labor Administration

Labor Administration, Edward T. Elbourne. Engineer, vol. 126, nos. 3276, 3278, 3279, 3280, Oct. 11 and 25, Nov. 1 and 8, 1918, pp. 299-300, 348-350, 2 figs., 365-367, 4 figs., 388-390, 1 fig. Oct. 25: Women;; Nov. 1: Time office (men); Nov. 8: Methods of Remuneration.

Dilution

Labor Dilution as a National Necessity, Frederick A. Waldron. Jl. Am. Soc. Mech. Engrs., vol. 40, no. 12, Dec. 1918, pp. 1033-1035. After referring to work done by British Bureau of Labor Dilution writer outlines scope of labor dilution as necessary application to national recources of U. S. Presented at annual meeting of society.

Employment Department

Employment Department Routine of the Curtiss Aeroplane & Motor Corp., Charles E. Fouhy. Ind. Man., vol. 56, no. 5, Nov. 1918, pp. 412-416, 17 figs. Routine and forms of employment department.

Industrial Relations

Employment of Labor, Dudley R. Kennedy. Jl. Am. Soc. Mech. Engrs., vol. 40, no. 12, Dec. 1918, pp. 1030-1031. Activities of Industrial Relations Department of Hog Island plant in connection with securing and maintaining a force of 35,000 employees and providing for their needs and comfort. Presented at annual meeting of society.

Fundamental Factors in Sound Industrial Relations, H. T. Waller. Ind. Management, vol. 56, no. 5, Nov. 1918, pp. 367-371, 8 figs. Seven factors discussed by author and illustrated by cartoons interpreting vital truth.

Use of Non-Financial Incentives in Industry, Robert B. Wolf. Jl. Am. Soc. Mech. Engrs., vol. 40, no. 12, Dec. 1918, pp. 1035-1038, 2 figs. Account of instances where personal interest has been developed in workmen by supplying foremen with information upon costs, methods of operation, possibilities in direction of economy and efficiency, etc. Presented at annual meeting of society.

Lunch Rooms

Feeding Employees at a Steel Plant. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1136-1138, 2 figs. Reasons for abolishing dinner pail; management of lunchroom; auxiliary room for foreigners; commissary.

National War Labor Board

The War Labor Board and the Living Wage, Frank P. Walsh. Survey, vol. 41, no. 10, Dec. 7, 1918, pp. 301-303. Account of origin of National War Labor Board, its purpose and achievements.

Profit Sharing

A Tested Profit Sharing Plan, Dale Wolf. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 486-488, 3 figs. Average of 46 per cent of company's profits are distributed to employees.

Soldiers

Returned Soldiers Make Very Good Welders, W. F. Sutherland. Can. Machy., vol. 20, no. 22, Nov. 28, 1918, pp. 618-619, 2 figs. Outline of work done by training school.

The Employment of the Returned Soldier. Can. Machy., vol. 20, no. 20, Nov. 14, 1918, pp. 561-562. Résumé of problem as viewed by English correspondent. From Times Eng. Supp.

The Industrial Restoration of Disabled Soldiers, Bert J. Morris. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 477-481, 4 figs. Review of accomplishments of other nations and notes on organizations preparing to re-educate American soldiers.

Turnover

Interpretating Labor Turnover, Luther D. Burlingame. Am. Mach., vol. 49, no. 19, Nov. 7, 1918, pp. 855-858, 1 fig. Discusses real meaning and how it should be computed.

Women

Women in the Machine Shop, S. A. Hand. Am. Mach., vol. 49, no. 23, Dec. 5, 1918, pp. 1035-1037, 9 figs. Successful experience of large firm of machine tool builders in employment of women workers.

Women Workers

Women in the Service of the Railways, Pauline Goldmark. Ry. Age, vol. 65, no. 23, Dec. 6, 1918, pp. 1016-1018. Used in a great variety of work. Address before Labor Reconstruction Conference, Academy of Political Science, N. Y.

LEGAL

Boiler Contracts

Construing Boiler Contracts, A. L. H. Street. Power, vol. 48, no. 22, Nov. 26, 1918, pp. 765-766. Case reported in the Maryland Court of Appeals, bearing on obligations of manufacturer under contract for installation of boilers according to particular specifications.

Casual Employment

What Constitutes Casual Employment? Chesla C. Sherlock. Am. Mach., vol. 49, no. 19, Nov. 7, 1918, pp. 850-852. Discussion of certain legal interpretations.

Contributory Negligence

Disobedience of Orders by Employees and Its Relation to Compensation. Chesla C. Sherlock. Am. Mach., vol. 49, no. 22, Nov. 28, 1918, pp. 980-982. Review of some court decisions.

Floors, Slippery (accidents from)

Injuries Caused by Slippery Floors, Chesla C. Sherlock. Power, vol. 48, no. 22, Nov. 26, 1918, pp. 790. Some court decisions.

Simple Tools (accidents from)

Liability in the Use of Simple Tools, Chesla C. Sherlock. Am. Mach., vol. 49, no. 21, Nov. 21, 1918, pp. 939-940. Some legal aspects of employers' liability in use of simple tools.

LIGHTING

Leather Industry

Need for Improved Lighting in the Leather Industry, F. H. Bernhard. Elec. Rev., vol. 73, no. 20, Nov. 16, 1918, pp. 759-765, 7 figs. Tenth of series of articles on lighting in industries.

Lighting (General)

Daylight vs. Sunlight in Sawtooth-Roof Construction, W. S. Brown. Jl. Am. Soc. Mech. Engrs., vol. 40, no. 12, Dec. 1918, pp 1025-1029, 5 figs. Empirical research of amount of direct sunlight and intensity of daylight to be admitted on working plane in sawtooth construction; equation to determine time of admission of direct sunlight and number of hours of its duration with given orientation of sawtooth buildings and slope of lighting area; influence of size and slope of sawtooth lighting area on relative intensity of daylight from northern sky; examples illustrating manner of computing amount of diffused light entering building under several conditions. Presented at annual meeting of the Soc.

Elements of Illuminating Engineering (III), Ward Harrison. Elec. Eng., vol. 52, no. 2, Aug. 1918, pp. 30-34, 4 figs. Essentials in illumination design—coefficients of utilization, location of light sources, and recommended minimum spacings and minimum heights above plan of illumination for various units.

Lighting in Its Relation to the Eye, C. E. Ferree and G. Rand. Proc. Am. Phil. Soc., vol. 57, no. 5, 1918, pp. 440-478, 9 figs. Report of work of sub-committee on Hygiene of the Eye of Am. Medical Assn., involving an extensive experimentation on effect of different lighting conditions on eye, and investigation of factors in lighting situation causing eye to lose in efficiency and experience discomfort.

Some Modern Methods of Lighting, Geo. H. Stickney. Nat. Engr., vol. 22, no. 10, Oct. 1918, pp. 469-477, 7 figs., and (discussion) pp. 477-479. Analysis of elements of lighting systems required by factories, offices and stores. Paper before Nat. Assn. of Stationary Engrs.

War-Time Lighting Economies. Elec. World, vol. 72, no. 19, Nov. 9, pp. 885-887. Salient features of report prepared by War Service Committee of Illuminating Engineering Society for U. S. Fuel Administration; fallacies to be avoided; making maximum use of daylight.

Reflecting and Diffusing Light

Reflecting and Diffusing Light, Ward Harrison. Textile World Jl., vol. 54, nos. 18, 20, 21 and 22, Nov. 2, 16, 23 and 30, 1918, pp. 61 and 71, 4 figs., 25-27, 1 fig., 59-63, 5 figs., and 33, 5 figs. Properties of accessories necessary for good industrial illumination.

Steel Mills

Better Lighting of Iron and Steel Mills and Fabricating Plants, F. H. Bernhard. Elec. Rev., vol. 73, no. 22, Nov. 30, 1918, pp. 841-845, 7 figs. Eleventh of series of articles on improvement of lighting in industries.

PUBLIC REGULATION

Government Trading

The Functions of the Government in Relation to Industry, W. L. Hichens. Iron & Steel Trades Jl., nos. 3099 and 3100, Nov. 2 and 9, 1918, pp. 488-489 and 514. Examination of advisability of carrying out suggestions that the Government engage in trading undertakings.

RECONSTRUCTION

Electrical Industry

Problems of the Reconstruction Era. Elec. World, vol. 72, no. 19, Nov. 9, 1918, pp. 877-878. Taking effective part in great world war, this country will necessarily be powerful factor in succeeding period; closer coöperation in electrical industry advocated.

Export Trade

Reconstructing Our Business Fabric. Shipping, vol. 5, no. 8, Nov. 23, 1918, pp. 15-16, 1 fig. Steps being taken and progress made to take advantage of present opportunity United States has of developing internationally.

SAFETY ENGINEERING

Boiler Rooms

Boiler Room Rules. Eng. & Cement World, vol. 13, no. 10, Nov. 15, 1918, p. 66. Suggestions to boiler-room attendants on the care of oilers and prevention of accidents. From Safety Bul.

Boiler Shops

Accident Prevention in Boiler Shops, Boiler Maker, vol. 18, no. 11, Nov. 1918, pp. 315-317, 5 figs. Account of what Bethlehem Steel Co. has accomplished and consideration of causes of accidents.

Disease Prevention

Engineers and Disease Prevention. Times Eng. Supp., no. 529, Nov. 1918, p. 231. Points out part engineers can play.

First Aid

Standardization of First Aid Methods, C. H. Connor. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 237-238. From Proc. Seventh Annual Safety Congress.

Foundries

Injuries from Molten Metal, Chesla C. Sherlock. Iron Age, vol. 102, no. 21, Nov. 21, 1918, pp. 1262-1262. Ordinary perils; defective tools and appliances; basis of foundryman's responsibility.

Water-Supply Protection

Protection of Water Mains, Fire Hydrants and Valves in Winnipeg, Thomas H. Hooper. Mun. Jl., vol. 45, no. 21, Nov. 23, 1918, p. 410. From Quarterly of Nat. Fire Protection Assn.

Woodworking Industry

Infections and Blood Poisoning in the Woodworking Industry, Leroy Philip Kuhn. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 228-230. From Proc. Seventh Annual Safety Congress.

SALVAGE

Salvaging and Utilizing Wastes and Scrap in Industry, W. Rockwood Conover. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 449-451. Significance of salvaging; reclaiming practice for number of classes of materials and wastes.

TRANSPORTATION

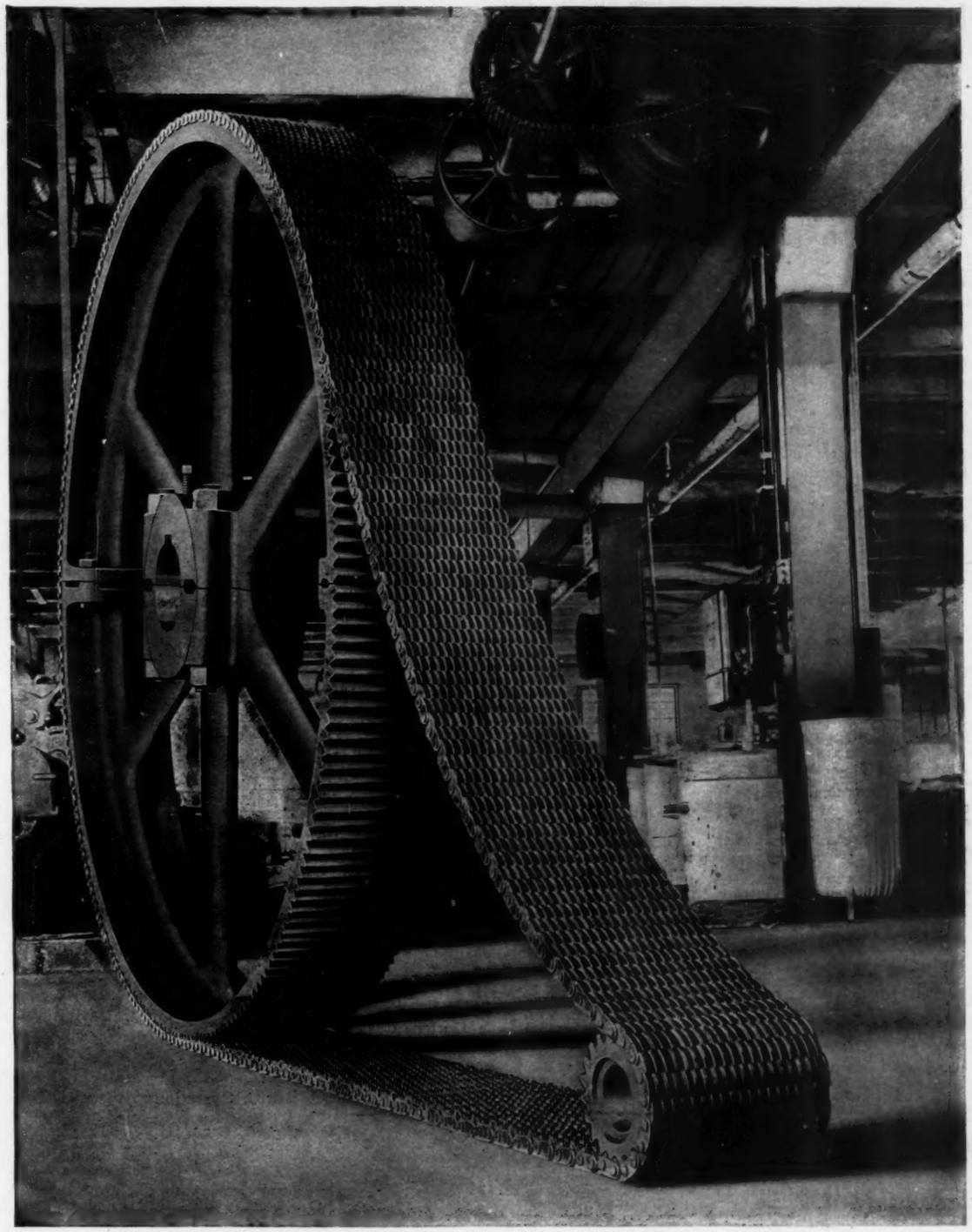
Comparative Methods

Light-Traffic Railway vs. Highway and Motor Truck, Clement C. Williams. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 984-985. Analyses of operating expenses, fixed charges and amount and kind of traffic should be made for each case.

Motor Trucks

Highway-Motor Truck Problem as Viewed by User, Manufacturer and Engineer. Eng. News-Rec., vol. 81, no. 22, Nov. 28, 1918, pp. 968-977, 2 figs. Three views. Limitations to be Placed on Trucks, from User's Viewpoint, by George H. Pride; Factors that Will Govern Future Road Design, by Edward L. Viets; Highways and Truck Loads they Can Economically Sustain, by H. Eltinge Breed.

Motor Truck Transportation Growing Rapidly. Ry. Rev., vol. 63, no. 22, Nov. 30, 1918, pp. 763-769, 11 figs. Formerly regarded as competitive, inter-city motor-truck traffic is now encouraged by railroads.



American High Speed Chain

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Industrial Technology

Alcohol

Industrial Alcohol. Times Eng. Supp., no. 529, Nov. 1918, p. 228. Possible sources of supply.

Asphalt

Chemical Constitution of Artificial Asphalts (La constitution chimique des asphaltes artificiels). Génie Civil, vol. 73, no. 13, Sept. 28, 1918, p. 256. Results of experiments with petroleum residues, lignite, tars and schist. From Zeitschrift für angewandte Chemie, June 11 and 18.

Coal Distillation

Distillation at Low Temperature. Gas Age, vol. 42, no. 11, Dec. 2, 1918, pp. 466-467. Discusses advantages of "coalite" process. From Journal des Usines a Gaz.

Low Thermal Distillation of Coals, G. W. Traer. Coal Industry, vol. 1, no. 10, Oct. 1918, pp. 393-395. Details of experimental plant; characteristics of semi-coke or charcoal; how to make a coke of suitable structure. Am. Inst. Min. Engrs. paper.

Dust Precipitation

Electrostatic Dust Precipitation, William H. Easton. Indus. Management, vol. 56, no. 6, Dec. 1918, pp. 473-475, 5 figs. Dust-laden gases become ionized when passing through field around grounded tubes inside which fine wires are charged with current at 50,000 to 100,000 volts.

Gas Manufacture

Coal Conservation in Relation to Gas Manufacture, Tim Duxbury. Gas Jl., vol. 144, no. 2895, Nov. 5, 1918, pp. 302-305 and (discussion) pp. 305-308. Results of experience with vertical retorts. Paper before Manchester Instn. of Gas Engrs. Also in Gas World, vol. 69, no. 1789, Nov. 2, 1918, pp. 262-263, 1 fig.

Economizing Coal in Gas Manufacture, Frederick Shewring. Gas World, vol. 69, no. 1789, Nov. 2, 1918, p. 261. Comments on steaming retorts.

Inclined Retort Plant at Rome, N. Y., A Success, S. Bent. Russell. Gas Age, vol. 42, no. 11, Dec. 2, 1918, pp. 463-466, 4 figs. Views and mechanism details of plant having daily capacity of 500,000 cu. ft. of gas.

Institution of Gas Engineers. Gas Investigation Committee. Gas Jl., vol. 144, nos. 2894 and 2895, Oct. 29 and Nov. 5, 1918, pp. 235-249, 3 figs. and (discussion) pp. 291-299. Report of sub-committee appointed to investigate relative efficiency in use of different grades and compositions of gas.

Glass

Substitutes for Glass. Sci. Am. Supp., vol. 86, no. 2235, Nov. 2, 1918, p. 283. Composition of siloxide and artificial mica; possibilities of derivatives of cellulose, oiled cotton cloth and vitro-cellulose. From La Nature.

Leather

Recent Developments in Leather Chemistry, Henry R. Proctor. Jl. Roy. Soc. of Arts, vol. 66, no. 3442, Nov. 8, 1918, pp. 776-781. Discussion of chemical and physical changes taking place in tanning process.

Naphthalene and Benzol

Estimation of Naphthalene in Coal Gas, Harold G. Colman. Gas Jl., vol. 144, no. 2894, Oct. 29, 1918, pp. 231-232. Modifications in Colman-Smith's method (vol. 75, p. 798.)

Notes on Benzol and Naphthalene Recovery, Harold E. Copp. Gas Jl., vol. 144, no. 2895, Nov. 5, 1918, pp. 311-313, 2 figs. Results obtained with plant installed at gas works. Paper before Midland Assn. of Gas Engrs. and Mgrs. Also in Gas World, vol. 69, no. 1789, Nov. 2, 1918, pp. 265-266.

Nitric Acid

Nitric Acid as a By-Product of Internal Combustion Engines, A. W. H. Griepe. Am. Gas Eng. Jl., vol. 109, no. 21, Nov. 23, 1918, pp. 487-489, 7 figs. and p. 492. Process to precipitate nitric oxide as by-product of internal-combustion engines, flue gases, illuminating gas, furnace gas, blast-furnace gas, natural gas, etc.

Oxygen and Hydrogen

Electrolytic Oxygen and Hydrogen. Travelers' Standard, vol. 6, no. 7, July 1918, pp. 137-145. Method of producing oxygen and hydrogen and their respective industrial applications.

Potash

Recovery of Potash from Blast Furnaces, Linn Bradley. Iron Age, vol. 102, no. 19, Nov. 7, 1918, pp. 1151-1153. From paper before Fourth Nat. Expos. of Chem. Ind., New York, September 1918.

Stoneware

Chemical Stoneware, Fred A. Whitaker. Brick & Clay Rec., vol. 53, no. 11, Nov. 19, 1918, pp. 875-877, 10 figs. Account of development of industry in United States.

Water Gas

Applications of Peat for the Production of Water Gas (Trvs Anvendelse til Fremstilling af Vandagas). Ingenioren, year 27, no. 86, Oct. 26, 1918, pp. 561-562.

Railroad Engineering

BRITISH

British Railways

British Railways Under War Conditions. Engineer, vol. 126, no. 3280, Nov. 8, 1918, pp. 390-391. What they cost the country. Eighth article.

ELECTRIC RAILROADS

(Not including Street and Interurban Lines)

Argentine Railways

Electric Traction on the Central Argentine Railway. Ry. Gaz., vol. 29, no. 18, Nov. 1, 1918, pp. 466-469, 4 figs. Cables; substations. (Continuation of serial.) Also in Engineer, vol. 126, no. 3279, Nov. 1, 1918, pp. 367-370, 12 figs.

Energy Consumption

Energy Consumption of Cars Is Affected by Temperature Changes, M. B. Rosevear. Elec. Ry. Jl., vol. 52, no. 22, Nov. 30, 1918, pp. 958-960, 2 figs. That power required for car operation is affected by variations in schedule speed, number of passengers carried and temperature is shown by extended study made by Public Service Railway, Newark, N. J.

Substations

Automatic Substations and Direct-Current Railway Systems (Les sous-stations automatiques et les réseaux de traction à courant continu). Revue Générale de l'Electricité, vol. 4, no. 11, Sept. 14, 1918, pp. 386-392, 7 figs. Details of operation; scheme of connections for 600-volt systems; tables of results obtained in actual installations.

See also ELECTRICAL ENGINEERING, Transformers (Substations).

ELECTRIFICATION

Montreal Tunnel

Montreal Tunnel Zone Electrification, William G. Gordon. Elec. Ry. Jl., vol. 52, no. 22, Nov. 30, 1918, pp. 962-965, 5 figs. Summary of details of rolling stock, overhead and substation equipment; design and construction problems. Abstract of paper before Am. Inst. of Elec. Engrs., Toronto, Nov. 1918.

EQUIPMENT

Ditcher

Electrically Operated Ditcher Effects Big Saving, Charles W. Ford. Elec. Ry. Jl., vol. 52, no. 22, Nov. 30, 1918, pp. 960-961, 5 figs. This is first electric machine built for ditching purposes; operates at 1200 or 1500 volts with 30-hp. motor.

LABOR

British Railways

British Railways Under War Conditions. Engineer, vol. 126, no. 3279, Nov. 1, 1918, pp. 371-372. Railwaymen's war bonus. Seventh article.

MAINTENANCE

Maintenance of Way Records and Reports. Ry. Rev., vol. 63, no. 19, Nov. 9, 1918, pp. 667-668. Methods being worked out by Railroad Administration for establishing accurate records; will standardize reports.

Pacific Electric's New Car Storage and Repair Facilities, Clifford A. Elliott. Elec. Ry. Jl., vol. 52, no. 21, Nov. 23, 1918, pp. 914-917, 11 figs. Description of three divisional storage track layouts with car houses and repair shops.

LOCOMOTIVES

Boiler for Mallet Locomotive

Large Boiler for New Mallet Locomotive. Boiler Maker, vol. 18, no. 11, Nov. 1918, pp. 303-304, 4 figs. Sections and elevations of boiler built for heavy grades, having firebox length of 181 1-16 in. and designed for 215-lb. working pressure.

Feedwater Heating

Locomotive Feed Water Heating, H. S. Vincent. Ry. Mech. Engr., vol. 92, no. 12, Dec. 1918, serial 1st part, pp. 645-649, 8 figs. Discussion of exhaust steam and waste gas methods of preheating.

French Compound

Recent Locomotives for the French State Railways, F. C. Coleman. Ry. Age, vol. 65, no. 20, Nov. 15, 1918, pp. 861-863, 4 figs. Principal data and descriptions of four-cylinder compound pacific type and simple consolidation type built in Great Britain.

Rock Island Heavy

2-10-2 Type Locomotive for the Rock Island Lines. Ry. Age, vol. 65, no. 23, Dec. 6, 1918, pp. 992-994, 6 figs. Novel and interesting features.

Santa Fe Heavy

A. T. & S. F. 4-8-2 Type of Locomotives. Ry. Mech. Engr., vol. 92, no. 12, Dec. 1918, pp. 649-652, 3 figs. Heaviest of type yet built. Principal dimensions and data.

Santa Fe Passenger

Mountain Type Locomotive for the Santa Fe. Ry. Rev., vol. 63, no. 20, Nov. 16, 1918, pp. 697-698, 3 figs. Description and principal data of heavy fast passenger locomotive. Also in Ry. Age, vol. 65, no. 22, Nov. 29, 1918, pp. 957-959, 1 fig.

Standard

Data for Standard Locomotives. Ry. Mech. Eng., vol. 92, no. 11, Nov. 1918, pp. 607-610, 12 figs. Tonnage rating charts and clearance and weight diagrams for government locomotives now built.

Standard Switcher

Standard Six-Wheel Switcher. Ry. Mech. Eng., vol. 92, no. 11, Nov. 1918, pp. 593-596, 5 figs. Principal data and description with drawings.

Superheating

Superheater Locomotive Performance. Ry. Mech. Engr., vol. 92, no. 12, Dec. 1918, pp. 652-655, 1 fig. Abstract of committee report presented at the 1918 Convention of the Traveling Engrs. Assn., with discussion.

Virginian Heavy Grade Pusher

Virginian 2-10-10-2 Locomotives. Ry. Mech. Eng., vol. 92, no. 11, Nov. 1918, pp. 600-604, 6 figs. Principal data and description with drawings. Built for heavy grade pusher service.

NEW CONSTRUCTION

American-Built Railroad Cutoff will Relieve Traffic Congestion in France, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 19, Nov. 7, 1918, pp. 832-835, 14 figs. A 5¾-mile double-track line for Expeditionary forces; big embankment chief feature; bridge half a mile long.

OPERATION AND MANAGEMENT

British Operation

Presidential Address to the Institution of Civil Engineers, John A. F. Aspinall. Ry. Gaz., vol. 29, no. 19, Nov. 8, 1918, pp. 487-494. British railway engineering and operation; immediate problems to be faced.

Fuel Conservation

Conservation of Fuel on the Railroads. Ry. Age, vol. 65, no. 21, Nov. 22, 1918, pp. 913-916. Abstracts of papers presented by railway men before New York Ry. Club.

Work of the Fuel Conservation Section, E. C. Schmidt. Ry. Rev., vol. 63, no. 22, Nov. 30, 1918, pp. 769-772. Organization and work of this department of Railroad Administration.

Supervision of Locomotives, British

District Supervision of Locomotives on British Railways, W. Patterson. Ry. Gaz., vol. 29, no. 18, Nov. 1, 1918, pp. 469-471. Review of work in a typical district with a staff of about 500 persons and sheds to which are allotted 150 engines.

Traffic Control

Controlling the Freight Traffic, North-Eastern Railway. Engineer, vol. 126, no. 3276, Oct. 11, 1918, pp. 305-306, 3 figs. Description of traffic control of North-Eastern Railway, and control board.

See also CIVIL ENGINEERING, Water Supply.

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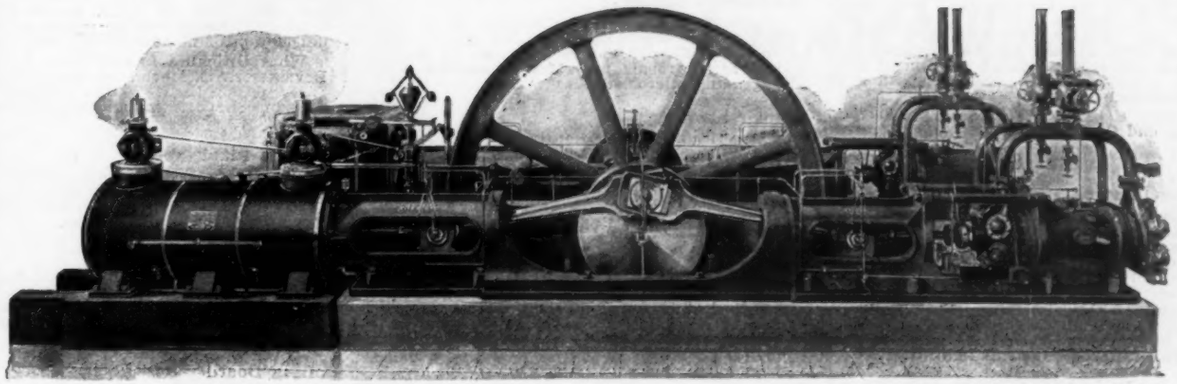

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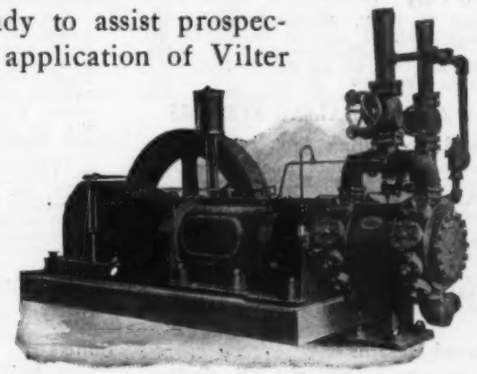

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PERMANENT WAY AND BUILDINGS

Floor Slabs and Culverts

Railway Practice in Design of Concrete Floor Slabs and Flat Top Culverts. Eng. & Contracting, vol. 50, no. 21, Nov. 20, 1918, pp. 511-512. Results of questionnaire by George H. Tinker. From Oct. Bulletin of Am. Ry. Eng. Assn.

Relocation of Lines

New York Central Relocates Lines to Cross Barge Canal at the Tonawandas. Eng. News-Rec., vol. 81, no. 20, Nov. 14, 1918, pp. 893-896, 2 figs. Detour two miles long around hearts of cities at once combines bridges over waterway and solves difficult problem of eliminating grade crossings and occupation of main business streets.

See also CIVIL ENGINEERING, Bridges, Building and Construction.

RAILS

Transverse Fissures

Transverse Fissures and Phosphorus Streaks in Rails, G. F. Comstock. Ry. Age, vol. 65, no. 22, Nov. 29, 1918, pp. 961-963, 2 figs. New evidence of influence of segregation and of advantage of reheating blooms. Abstract of paper before Am. Inst. of Min. Engrs.

Transverse Fissures Cause Rail Failures. Ry. Age, vol. 65, no. 23, Dec. 6, 1918, pp. 1007-1009. Abstract of James E. Howard's report of the rail failure at Central Islip, N. Y.

ROLLING STOCK

Cleaning

Passenger Car Cleaning on the Canadian Pacific Railway, E. Eley. Can. Ry. Club, vol. 17, no. 6, Sept. 1918, pp. 19-22, and (discussion) pp. 23-31. Nature and amount of work required by different classes of cars.

Coal Cars

Design of Seventy-Ton Coal Car with Tandem Hoppers. Ry. Mech. Eng., vol. 92, no. 11, Nov. 1918, pp. 611-613, 5 figs. Principal data with description and drawings.

Flat Cars

Shipping Large Marine Boilers. Boiler Maker, vol. 18, no. 11, Nov. 1918, p. 307, 1 fig. Describes special flat car for shipping Scotch boilers. From Marine Jl.

Lighting

Standards of Passenger Car Lighting. Ry. Rev., vol. 63, no. 19, Nov. 9, 1918, pp. 672-673. Specifications prepared by mechanical department of United States Railroad Administration for electric lighting of passenger equipment cars hereafter to be purchased by administration for use of roads under its control.

Refrigerator Cars

Standard U. S. R. A. Refrigerator. Ry. Mech. Engr., vol. 92, no. 12, Dec. 1918, pp. 663-668, 7 figs. Latest practices in design. Also in Ry Age, vol. 65, no. 21, Nov. 22, 1918, pp. 906-910, 4 figs.

SAFETY AND SIGNALING SYSTEMS

Coupling and Uncoupling

Prevention of Accidents Due to Coupling and Uncoupling Cars. E. M. Switzer. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 262-264. From Proc. Seventh Annual Safety Congress.

Interlocking

Single Line Interlocking on the New South Wales Railways. Ry. Gaz., vol. 29, no. 19, Nov. 8, 1918, pp. 495-497, 4 figs. Outline of system of interlocking and signalling line stations.

Plant Railroad Hazards

Plant Railroad Hazards, C. H. Baltzell. Safety Eng., vol. 36, no. 4, Oct. 1918, pp. 252-256, 2 figs. Possibilities of personal injuries in plants situated on main line tracks and manner of avoiding them. From Proc. Seventh Annual Safety Congress.

Signaling

Proceedings, Annual Meeting, New York, N. Y., Sept. 19-20, 1918, Ry. Signal Assn., Jl. 23d year. No. 4, Dec. 1918, pp. 313-420, 4 figs. Addresses, committee reports, etc.

SHOPS

Boiler-Tube Fitting

Modern Locomotive Boiler Tube Practice at Doncaster Works, Great Northern Railway. Ry. Gaz., vol. 29, no. 19, Nov. 8, 1918, pp. 499-500, 4 figs. Methods employed for fitting and expanding boiler tubes and superheater flues.

Car Repairs

Car Department of the Milwaukee. Ry. Mech. Eng., vol. 92, no. 11, Nov. 1918, pp. 615-620, 9 figs. Organization and methods of handling light and heavy car repairs with samples of forms used.

Grinding

Grinding in Locomotive Shops, M. H. Williams. Ry. Mech. Eng., vol. 92, no. 11, Nov. 1918, pp. 629-632, 4 figs. Uses to which internal, cylindrical and surface grinding machines may be put with success.

Locomotive Repairs

Accuracy in Locomotive Repairs, M. H. Williams. Ry. Mech. Engr., vol. 92, no. 12, Dec. 1918, pp. 673-677, 8 figs. Methods of making and fitting repair parts for locomotives with gages and micrometers.

Repair Shops

American Railroad Repair Shops in France, Robert K. Tomlin, Jr. Am. Mach., vol. 49, no. 21, Nov. 21, pp. 933-938, 7 figs. How these shops were built by American engineers in France.

SPECIAL LINES

Logging Roads

Soldiers Build Logging Roads in Spruce Forests, W. A. Welch. Ry. Age, vol. 65, no. 19, Nov. 8, 1918, pp. 805-807, 6 figs. Description of construction of over 350 miles of new railway in Northwest for carrying airplane lumber to mills.

See also CIVIL ENGINEERING, Harbors.

Munitions and Military Engineering

Ballistics

A Field Ballistic Problem, Meade Wildrick. Jl. U. S. Artillery, vol. 49, no. 3, May-Aug. 1918, pp. 159-186, 9 figs. Numerical illustration of (1) construction of range table, (2) construction of range correction curves, (3) construction of deflection correction chart, (4) correction for variation in muzzle velocity due to a variation in weight of projectile, and (5) correction for variation in temperature of powdered charge.

Effect of the Earth's Rotation Upon the Point of Fall, Fred M. Green and C. W. Green. Jl. U. S. Artillery, vol. 49, no. 3, May-Aug. 1918, pp. 192-204, 10 figs. Derives, from consideration of effect of difference in velocity of gun and target due to earth's rotation, approximate expressions for corrections required in trajectory of projectile fired at long range.

Notes on Inclined Trajectories, F. M. Green and C. W. Green. Jl. U. S. Artillery, vol. 49, no. 3, May-Aug. 1918, pp. 187-191, 1 fig. Suggest manner of constructing table of discrepancies between results obtained by Ingalls' formula and by simplified form $\Phi = \Phi x + \epsilon$ where Φ is the quadrantal angle of departure, Φx the range table angle of departure to attain range, and ϵ angle of elevation of target.

Simpson's Resection, Stanley H. Simpson. Jl. U. S. Artillery, vol. 49, no. 3, May-Aug. 1918, pp. 208-214, 3 figs. Explains method in which, angles being measured in mils, instead of plotting actual arcs, short chords of these arcs are plotted on a scale large enough to make chords practically coincident with arcs.

The Elliptic Trajectory Over the Earth, G. Greenhill. Engineering, vol. 106, no. 2754, Oct. 11, 1918. A mathematical article.

Bullets

Explosive, Expansive and Perforating Bullets, Claude Pernelle. Sci. Am. Supp., vol. 86, no. 2238, Nov. 23, 1918, pp. 332-333, 5 figs. Types used by German and Austrian armies. Translated from La Nature.

Howitzers

How the 155-Mm. Howitzer is Made, J. V. Hunter. Am. Mach., vol. 49, nos. 21 and 22, Nov. 21 and 28, 1918, pp. 941-945, 17 figs., and 983-986, 14 figs. Work on howitzer jacket after it has been rough-machined and heat-treated. Nov. 28: Making the tube.

Mobile Batteries

Railroad Men Man Mobile Battery for Navy. Ry. Age, vol. 65, no. 22, Nov. 29, 1918, pp. 967-969, 4 figs. Description of 14-inch naval guns on railway mounts which worked destruction behind German lines.

Ordnance Manufacture

Finding the "Choke Points" of Ordnance, John H. Van Deventer. Am. Mach., vol. 49, no. 22, Nov. 28, 1918, pp. 967-971, 6 figs. One of series of articles on work of Ordnance Dept.

Munitions Production by British Railways. Ry. Rev., vol. 63, no. 19, Nov. 9, 1918, pp. 671-672. Account of reorganization of railway shops in Great Britain to become one of England's chief sources of supply for munitions of war. Adapted from Board of Trade Journal, London.

The Manufacture of Guns (La fabrication des canons), Ch. Dantin. Génie Civil, vol. 73, no. 1875, July 20, 1918, pp. 41-47, 21 figs. Considerations governing choice of metal and description of manufacturing process.

What Ordnance Is and Does, John H. Van Deventer. Am. Mach., vol. 49, no. 20, Nov. 14, 1918, pp. 876-881, 7 figs. Organization of Ordnance Department and what it does. First article.

Ordnance Plant

A War-Time American Ordnance Plant. Iron Age, vol. 102, no. 22, Nov. 28, 1918, pp. 1326-1328, 5 figs. Description of new plant of Tacony Ordnance Corporation.

Shells

The Manufacture of Semi-Steel Shells. Iron Age, vol. 102, no. 22, Nov. 28, 1918, pp. 1317-1321, 32 figs. Practice as recommended by Ordnance Department; chemical, metallurgical, molding and machining details.

Spotting Board

Spotting Board, G. R. Meyer. Jl. U. S. Artillery, vol. 49, no. 3, May-Aug. 1918, pp. 205-207, 1 fig. Constructed to furnish battery commander with information as to longitudinal deviation of his shots.

See also MECHANICAL ENGINEERING, Foundries (Semi-Steel).

General Science

CHEMISTRY

Electrolytic Conductivity

Electrolytic Conductivity in Non-Aqueous Solutions. II. The Electrical Conductance of Trimethyl-Para-Tolyl-Ammonium Iodide in Water and Several Organic Solvents, Henry Jermain, Maude Creighton and D. Herbert Way. Franklin Inst. Jl., vol. 186, no. 6, Dec. 1918, pp. 675-698, 7 figs. Investigations.

Elements

Atomic Number and Frequency Differences in Spectral Series, Herbert Bell. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 337-347, 2 figs. Numerical tests of Rydberg's law that square root of doublet and triplet differences is proportional to atomic weights, substituting atomic number for atomic weight.

Elements in the Order of Their Atomic Weights, Raymond Szymanowitz. Chem. News, vol, 117, no. 3059, Oct. 25, 1918, pp. 339-340. Presents table which shows numbers follow scheme of sequence expressed by: X, $X + 3$, $X + 3 + 1$, $X + 3 + 1 + 3$, etc., adding 1 and 3 alternately.

Solutions

The Electrical Conductivity of Acids and Bases in Aqueous Solutions, Jnanendra Chandra Ghosh. Jl. of the Chem. Soc., vols. 113-114, no. 672, Oct. 1918, pp. 790-799. Explains abnormally high mobility of hydrogen and hydroxyl ions in aqueous solutions on assumption that electricity is partly carried by ordinary process of convection and partly propagated through water molecules undergoing alternate dissociation and recombination; apparently high activity of strong acids and bases is also traced to this cause; modifies Ostwald equation for electrolytes where degree of dissociation is less than one.

Structure of Matter

Atomic Structure from the Physico-Chemical Standpoint. Alfred W. Stewart. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 326-336, 1 fig. Model atom proposed as having a structure accounting for all the facts known concerning elements, including radioactive transformations.

Interfacial Tension and Complex Molecules, G. N. Autonoff. Lond. Edinburgh & Dublin, Phil. Mag., vol. 36, no. 215, Nov. 1918, pp. 377-396, 5 figs. Theory of molecular attraction based on modern representation of nature

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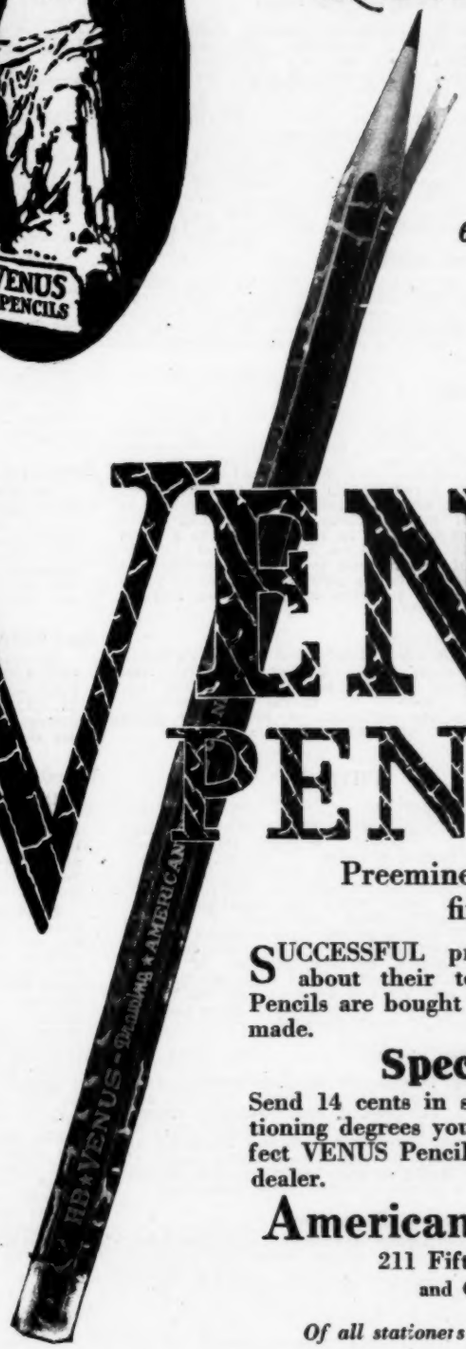

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of atoms and molecules; explanation of phenomena of molecular attraction by action of forces which cause chemical affinity; deduction of relation between surface tension and molecular pressure.

Valency

Definition of Valency, F. H. Loring. Chem. News, vol. 117, no. 3058, Oct. 11, 1918, pp. 319-322. Simile to explain significance of term and nature of atoms which exercise variable valencies.

MATHEMATICS

Analytical Functions

Factoring and Prolongation of Analytical Functions (Quelques remarques sur la décomposition en facteurs primaires et le prolongement des fonctions analytiques), Emile Picard. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 12, Sept. 16, 1918, pp. 405-408. Further comment on Weierstrass' method of decomposition. In Comptes-rendus, vol. 92, 1881, p. 690, author showed application of this method to uniform functions whose roots approach indefinitely a given line.

Conics

Involutions on the Rational Cubic, R. M. Winger. Bul. Am. Math. Soc., vol. 25, no. 1, Oct. 1918, pp. 27-34. Establishes that lines joining pairs of contacts of tangents from points of R^3 envelop conic N which touches nodal tangents (where they meet line of flexes) and has contacts with R^3 at sextactic points; also other theorems in regard to properties of hyperosculating curves of R^3.

Divergent Series

A Conspectus of the Modern Theory of Divergent Series, Walter B. Ford. Bul. Am. Math. Soc., vol. 25, no. 1, Oct. 1918, pp. 1-15. Review of modern theory of divergent series in regard to (1) the question as to how a sum may be assigned to a divergent series in general, and (2) the functional properties of asymptotic series; proposed limitations to form a consistent general theory of summation.

Equations

A Determinantal Equation Whose Roots are the Products of the Roots of Given Equations, William H. Metzler. Proc. Roy. Soc. of Edinburgh, vol. 38, part 1, session 1917-1918, pp. 57-60. By multiplying one by one successive equations from k linear homogeneous sets (1), (2), ... (k) in n_1, n_2, ... n_k variables a new set is formed. The new set will contain $n = n_1 \cdot n_2 \cdot \ldots \cdot n_k$ equations in same number of variables and its determinant when equated to zero is the proposed determinantal.

Simultaneous Linear Differential Equations Involving Partial Derivatives and Reduction of Hyper-Geometric Functions of Two Variables (Sur des équations linéares simultanées aux dérivées partielles et sur des cas de réduction des fonctions hyper-géométriques de deux variables), Paul Appell. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 12, Sept. 16, 1918, pp. 408-413.

Solution of Partial-Derivative Equations by Means of Hermite's Polynomials (Sur les équations aux dérivées partielles vérifiées par les polynomes d'Hermite, déduits d'une exponentielle), Pierre Humbert. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 15, Oct. 7, 1918, pp. 522-525. Application of Appell's method (Comptes rendus, vol. 167, 1918, p. 309) to variables obtained from differentiation of exponential function whose exponent is of quadratic form in X and Y.

Solutions of Differential Equations as Functions of the Constants of Integration, Gilbert Ames Bliss. Bul. Am. Math. Soc., vol. 25, no. 1, Oct. 1918, pp. 15-26. Proposes method.

Treatment of Partial-Derivative equations by Hyperspherical Polynomials (Sur les systèmes d'équations aux dérivées partielles vérifiés par les polynomes hypersphériques), J. Kampé de Fériet. Comptes rendus des séances de l'Académie des Sciences, vol. 167, no. 15, Oct. 7, 1918, pp. 519-522. Study of case of n linear equations involving partial derivatives of second order.

Fourier Series

On the Cesaro Convergence of Restricted Fourier Series, W. H. Young. Proc. Roy. Soc., vol. 95, no. A665, Sept. 2, 1918, pp. 22-29. Establishes from operations on trigonometric series $\Sigma (a_r \cos r X + b_r \sin r X)$ that Legendre series converges (C ½) almost everywhere in interval ($o < X < 1$), and that it converges (C ½) at every internal point X of this interval at which $f(X)$ is continuous, or is the differential coefficient of its integral, or satisfies some other condition sufficient to insure convergence (CK), for same value of $K > ½$, of Fourier series of a function equal to $f(\cos \theta)$ in a small interval containing point Z considered ($X = \cos \Theta$ ($o < X < 1$).

Invariants

Related Invariants of Two Rational Sextics, J. E. Rowe. Bul. Am. Math. Soc., vol. 25, no. 1, Oct. 1918, pp. 34-35 Points out relation between invariants of the R^6_2 and invariants of the R^6_2.

Isogenous Complex Functions

Note in Isogenous Complex Functions of Curves, W. C. Graustein. Bul. Am. Math. Soc., vol. 24, no. 10, July 1918, pp. 473-477. Derivation of theorem: if gradients c_1, c_2 of functions F_1, F_2 in $F = F_1 + i F_2$ where $F_1 = F_1, |[L]|$, $F_2 = F_2 |[L]|$ are first-degree functions of space curve L, are in general analytic, then the gradients γ_1, γ_2 of Φ_1, Φ_2 in $\Phi = \Phi_1 + i \Phi_2$, an arbitrary complex function of L of the first degree isogenous to F, are analytic save in points of singularity of c_1 or c_2 and points in which these vectors are indeterminate. $F |[L]|$ represents a function of L such that $F |[- L]| = - F |[L]|$.

Orthogonal Substitution

Note on the Construction of an Orthogonant, Thomas Muir. Proc. Roy. Soc. of Edinburgh, vol. 38, part 2, session 1917-1918, pp. 146-153. Comments of and addition of theorems to Cayley's mode of forming an orthogonal substitution.

Polynomials

A Reduction Formula for the Functions of the Second Kind Connected with the Polynomials of Applied Mathematics, Pierre Humbert. Proc. Roy. Soc. of Edinburgh, vol. 38, part 1, session 1917-1918, pp. 61-69. Method by which a polynomial $B_n(Z)$ of degree $n-1$ satisfying certain conditions is introduced in practical computations involving Legendre's functions in order to reduce them to a form $f_{n-1}(z) = [z P_n(z) - B_n(z)]$ (z^2-1); application of this method to Lame's functions, to extended Legendre's polynomials and to parabolic-cylinder function when n is an integer.

Probability

An Elementary Derivation of the Probability Function, Albert A. Bennett. Bul. Am. Math. Soc., vol. 24, no. 10, July 1918, pp. 477-481. Derives by means of elementary considerations equation of probability from sequence of binomial coefficients.

PHYSICS

Flame Propagation

The Propagation of Flame through Tubes of Small Diameter, William Payman and Richard Vernon Wheeler. Jl. Chem. Soc., vols. 113 & 114, no. 670, Aug. 1918, pp. 656-666, 3 figs. Report of experiments, performed in connection with work on construction of miners' safety lamp, on speed of uniform movement during propagation of flame in mixtures of methane and air through tubes of small diameter, on the passage of flame through similar tubes filled with mixtures of methane and air and open at both ends, and on the passage or projection of flame through short tubes of small diameter.

Fluorescence

On the Phenomena of Fluorescence, Desmond Geoghegan. Chem. News, vol. 117, no. 3058, Oct. 11, 1918, p. 322. Suggests experiment which, it is said, will prove that rays of light passed through a sufficient thickness of a fluorescent substance lose thereby power of exciting fluorescence when they are passed through a second layer of same substance.

Magneto-Thermal Phenomena

Magneto-thermal Phenomena (Le phénomène magnétocalorique), Pierre Weiss and Auguste Piccard. Journal de Physique, vol. 7, May-June 1917, pp. 103-109, 1 fig. Account of pronounced changes in temperature which were observed in course of experimental measurements preliminary to plotting set of isothermals for nickel. Near Curie's point temperature increased 0.7 deg. on establishing field of 15,000 gausses.

Optics

The Correction of Telescopic Objectives, T. Smith. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 215, Nov. 1918, pp. 405-412. Criticism of expressions for constructional data for small objectives as given by A. O. Allen in Phil. Mag. June 1918.

The Scattering of Light by Air Molecules, R. J. Strutt. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 214, Oct. 1918, pp. 320-321. Supplements former account of experiments (Proc. Roy. Soc. A., vol. 44, p. 453, 1918) by answering inquiry from R. W. Wood (Phil. Mag., vol. 36, p. 272, Sept. 1918) in regard to precautions taken for drying air in experiments.

Quanta Law

Researches on the Limit of the Continuous Spectrum of X-Rays (Recherches sur la limite du spectra continu des rayons X), Alex. Muller. Archives des Sciences Physiques et Naturelles, year 123, vol. 46, Aug. 1918, pp. 63-73, 1 fig. Theoretical and experimental vertification of Planck's law of quanta as generalized by Einstein by confirming the relation $e V = h \nu$ in the case of the continuous spectrum of X-rays, and for an interval from 14 to 28 kilovolts.

Radium

On Some Properties of the Active Deposit of Radium, S. Ratner. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 215, Nov. 1918, pp. 397-405, 2 figs. Experimental research which leads author to question whether phenomenon of recoil of RaC from RaB has ever been observed, also that proportion of recoil atoms of RaB carrying negative charge is less than 1 to 100,000.

Relativity

On the Essence of Physical Relativity, Joseph Larmor. Proc. Nat. Academy of Sci., vol. 4, no. 11, Nov. 1918, pp. 334-337. Offers objection to Leigh Page's expression (no. 4, p. 46) for translatory force required to sustain assigned varying velocity in electrostatic system of type usually investigated as model of electron.

Semi-Fluids

Mechanics of Semi-Fluids (Mécanique des semi-fluides). Comptes Rendus des Séances de l'Académie des Sciences, vol. 167, no. 7, Aug. 12, 1918, pp. 253-256. Discusses possibility of disregarding tangential action of central cylinder on annular part of the limiting surfaces.

Vibrations and Wave Motions

Diffraction of Plane Waves by a Screen Bounded by a Straight Edge, F. J. W. Whipple. Lond. Edinburgh & Dublin Phil. Mag., vol. 36, no. 215, Nov. 1918, pp. 420-424. Adaptation of R. Hargreaves' method for simple harmonic wave (Phil. Mag., vol. 36, p. 191), to diffraction of waves of arbitrary type.

Periodic Irrotational Waves of Finite Height, T. H. Havelock. Proc. Roy. Soc., vol. 95, no. A665, Sept. 2, 1918, pp. 38-51. Extension of Mitchell's form for highest wave and its generalization by means of surface conditions: method of approximation for coefficient; calculation for highest wave; values when $e^{-2\delta} = ¾$; comparison with Stokes' series; determination of b^1; numerical examples and remarks upon coefficients.

The Interferometry of Vibrating Systems, C. Barus. Proc. Nat. Academy of Sci., vol. 4, no. 11, Nov. 1918, pp. 328-333, 4 figs. Report of experimental work.

The Sound Waves and Other Air Waves of the East London Explosion of January 19, 1917, Charles Davison. Proc. Roy. Soc. of Edinburgh, vol. 38, part 2, session 1917-1918, pp. 115-129, 1 fig. Construction of paths followed by air waves and sound waves; offered explanation for fact that inaudible air waves were observed beyond limits of sound areas by reason of their more nearly horizontal path.